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CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY.

The complete programme printed elsewhere of the Convention of the Illuminating Engineering Society, to be held next week in Philadelphia, assures in itself a highly successful meeting, as a majority of the papers are of an unusual intrinsic importance. In addition, the discussions promise to be of exceptional value. All papers were sent out in advance, and replies to an accompanying request to indicate the paper or papers which a member may desire to discuss, have, we learn, been almost embarrassingly encouraging. As papers will only be presented by title, practically all the time of sessions will be available for discussion; and the remarks being prepared in advance, the perfunctory variety should happily be notable by its absence. The Philadelphia Committee of Arrangements has provided an admirable programme of entertainment, and in particular has taken pains that members and guests shall be enabled to view from points of advantage the several more interesting features of the elaborate celebration, commencing Monday, which the Quaker City has arranged to commemorate its founding 225 years ago.

STREET LIGHTING.

Elsewhere we print an article by Dr. Louis Bell which forcibly brings out the inferiority of street illumination in this country when compared with prevailing European practice. Perhaps the strongest impression made upon the American central station man or electrical engineer on his first trip abroad, is from his observation of the brilliancy of the illumination of the principal streets of the larger European cities. As pointed out by Dr. Bell, this is not the result of cheap electrical service, as the rates abroad are as a rule higher than in corresponding cities in this country; and since Europeans gage expenditures for public service by the same economical standards observed in private life, the conclusion is that abroad brilliant illumination of the principal streets is considered a prerequisite of modern life. While occasionally in this country a street may be found as brilliantly illuminated as abroad, the case is not only exceptional but probably in almost every instance is the result of some fortuitous circumstance and not part of any systematic plan of street lighting. The inadequacy of street lighting in this country offers a fine opportunity to the central station; for if the subject is properly handled and the municipal authorities are brought to view the question from the standpoint of what street illumination should be if our cities are to be classed in this respect with those of effete Europe, the income of the station should largely benefit, both directly, and also indirectly from the higher standards of interior illumination that will follow.

Question of Coal Supply.

The first hopeful sign with respect to fuel supply that we have seen is a recent wail of the coal men that electricity hurts the soft coal trade. It surely is an admirable evidence of the good that electric traction does if it really is making itself felt in the trade as a factor in reducing demand. It is the fashion among some coal operators to decry the predictions of serious decrease in the supply, and by way of whistling to keep their courage up, to tell of vast deposits yet untouched and sometimes newly discovered. Now, from our standpoint the more new fields discovered the better, but while they look enormous from the standpoint of the householder, in view of the world's fuel demand they shrink to disquieting dimensions. In spite of the introduction of electric traction and electrical transmission from water power, the demand for coal in the aggregate goes on increasing at a formidable rate. Individually operators may find that certain customers—railways, for instance—that have gone over to electric traction have a lessened use for fuel, but statistics are squarely against any materially decreased rate of increase in the general demand. If the rate of the present merely holds its own without the acceleration steadily observable, it will be hardly more than a decade before the consumption of soft coal reaches three-quarters of a billion tons per year. At such a rate of destruction the end of good and easily worked deposits is fairly in sight. The coal lands in the United States are immense in extent, but the coal in most of the area is far from high grade. Much of it, in fact, is lignite or little better. Of the better coal, much of the possible supply is so situated that the cost of working or of transportation is likely to be exceptionally large.

To examine in the rough the effect of electrical power transmission from water power on the coal demand is not difficult. Assume, for example, a transmission of 1,000,000 horsepower. The engines replaced would probably require, say, 5 lb. per hp-hour as an outside average on the whole, and counting the usual industrial 3000 hours per year, this would amount to but 7,500,000 tons. Allowing for some twenty-four-hour power and for the replacement of a considerable number of locomotives, the service in coal would still hardly exceed 10,000,000 tons per year, and this is by no means a large fraction of the present rate of yearly increase in use. It would not, in fact, make a material difference from the general standpoint of fuel supply. That the sudden decrease in the demand would disturb the coal market is doubtless true. Coming slowly, however, as the increase in transmission actually does, it is thus far a mere drop in the bucket. The fuel consumption continues to increase at a rapidly rising rate. More, perhaps, is to be hoped from the betterment of conditions in using fuel. There is every reason to believe that boiler economy and engine economy can both be very materially improved; yet, unless the world's needs change their pace, the demand for fuel will continue to rise far too rapidly to be compensated by any improvements now in sight. It is, of course, hardly possible that the increase will go on indefinitely until the supply of coal is literally exhausted. The thing which will happen is that the use of coal as fuel will be checked by the inevitable increase of price that must follow the necessity for working deep and inconvenient veins and for long and costly transportation

Already anthracite, as the popular fuel of the East, is doomed. The consumption rate now existing must bring about still further rise in price until people will be forced to use soft coal as is usual elsewhere in the world, and anthracite must before many years join cannel coal as an interesting luxury. There should be continual effort toward the effective realization of lignite and low grade coal so as to bring into use the whole range of available fuels. On the Continent the Bohemian brown coal, which is of low thermal value, is successfully utilized and, what is more, can be burned practically without smoke in proper furnaces. The successful utilization of peat is another important problem to be solved. The raw peat supply is enormous, and if there were a good and cheap process for sorting it and putting it into briquettes it would be a very important addition to the fuel supply. To a small extent peat is now prepared and used abroad, but the industry is not yet a considerable one. One of the chief troubles with peat, of course, is its very uneven quality and the difficulty of separating the good from the bad. As coal goes up in price there will be sufficient incentive to use peat to spur on commercial investigation. A very different source of power which may assume some day great importance is alcohol used in internal combustion engines. At a pinch enough low grade vegetable matter suitable for alcohol production can be annually raised to make a considerable impression in the industries. This, of course, transfers the attack on stored material to the soil, which can now fortunately be replenished by artificial fertilizers which will help distribute the burden of destruction. The ideal condition would be to utilize such a cycle as would eventually be recuperated by solar energy. This is fairly well realized by the production of alcohol from vegetable matter, and it seems about the only chance of recovering the carbon reduced to CO_2 in the productive part of the energy cycle. It would be an interesting study to compare this process with the direct utilization of solar energy. The vegetation cycle has the obvious advantage of producing energy which can be stored for long periods at small cost and utilized at any convenient rate.

Modern Illuminants and Ultraviolet Rays.

At the annual convention of the Verband Deutscher Elektrotechniker, held this summer in Erfurt, a discussion took place on the question of the possible injury to the eyes from ultraviolet rays produced by modern illuminants. In this discussion two very interesting papers were presented on opposite sides of the question. In one paper Dr. Fritz Schanz and Herr Carl Stockhausen, an engineer, presented certain established physiological facts in connection with ultraviolet light. Ultraviolet rays are not responded to by the retina. That is, we cannot see by ultraviolet light reaching the retina. The crystalline lens in the eye fluoresces, however, under ultraviolet radiation and in this way may convert some ultraviolet invisible radiation into infraviolet visible light. Ultraviolet rays are, it is stated, capable of injuring the retina, as in snow-blindness, produced by the reflection of sunlight from the snow on mountain tops at altitudes where the ultraviolet rays of the sun are much stronger than they are at or near sea level, after they have passed through and have suffered absorption in the deeper layers of our atmosphere. Ultraviolet rays from arc lamps are also stated to be capable of injuring the eyes. The name of electric

ophthalmia is attached to an affection of the eyes attributed to over-stimulation by powerful arc light. The paper further suggests the possibility of danger from cataract of the eyes due to ultraviolet rays, intimating that the undue stimulation of the crystalline lens into fluorescence by ultraviolet light may tend to bring on the opacity which in old age is called senile cataract.

The paper next presents a series of spectro-photographs obtained from different luminous sources. The rays of light which fall within the visible spectrum have wave-lengths approximately from 0.8 μ at the red end, to 0.4 μ at the violet end, 1 μ, called the micron, being the one-millionth part of a meter. Waves of shorter length than 0.4 μ are invisible, and are called ultraviolet waves. Photographic plates are responsive to ultraviolet light, and enable the ultraviolet spectrum to be photographed. Glass absorbs light strongly beyond the violet, and is ordinarily opaque to ultraviolet light of shorter wave-length than 0.3 μ. Consequently, glass lenses and prisms cannot be used in photographing ultraviolet light beyond that limit; but quartz is transparent to ultraviolet light far beyond this limit, so that quartz lenses and prisms are employed for such purposes. The photographs demonstrate that ordinary incandescent lamps, especially those with filaments of osmium, tantalum and tungsten, produce ultraviolet rays, although their enclosing glass globes absorb them beyond the limit, 0.3 μ. Arc lamps are still more powerful sources of ultraviolet rays, and in the absence of a glass globe, produce them up to the neighborhood of wave-length 0.2 μ.

The paper contends that glass globes or covers surrounding powerful electric lamps do not afford sufficient protection from ultraviolet rays, since ultraviolet rays of length between 0.4 μ and 0.3 μ are not cut off. The authors claim, however, to have produced a new kind of glass with a greenish-yellow tint, which they call Euphos-glass, and which, in the form of shades or covers to the above-mentioned electric lamps, cut down the issuing wave-lengths beyond 04. μ, the approximate visual limit. It is stated that within the visual limits of wave-length 0.8 μ to 0.4 μ, the Euphos-glass shades do not materially increase the light absorption incident to ordinary glass. It is thus suggested that all powerful electric lamps should be provided with Euphos-glass shades or covers. In the course of a lively discussion on the questions raised by this paper, it was pointed out that according to the same reasoning all our windows should contain Euphos glass in order to keep the wicked ultraviolet rays of the sun from entering our houses. In fact, no person should go out of doors for a moment without being protected against ultraviolet sunshine by Euphos-glass spectacles.

The second paper, above referred to, was later presented by Herr Voege. It gave the results of a comparative research upon daylight and artificial lights in regard to their ultraviolet radiation. A photographic camera with a quartz lens was provided with a double reflecting system in such a manner that half of the sensitive plate was illumined by daylight from the sky, and the other half from the lamp under test. The distance of the test lamp was adjusted until, to the eye, the intrinsic brightness of the two sides of the field appeared alike. Photographs were then made, both with unobstructed beams and with the visual rays cut off by a liquid screen of nitrosodimethylanilin, a substance which is opaque to visual rays, but transparent to ultraviolet rays. The photographs indicate that, in general, the illumination from clear blue sky contains more ultraviolet rays than the same intensity of illumination from any artificial source, except perhaps some types of naked arc lamp, and the quartz-tube, mercury-vapor lamp. The conclusion is drawn from these photographs that when a given suitable intensity of illumination is produced upon a table or book, any artificial light thus far produced is weaker in ultraviolet rays than the same intensity of daylight. A second series of observations is also reported in the paper, in which direct photographs were made from reflected 10-o'clock morning sunlight compared with similar photographs from reflected arc light, Nernst light and tungsten incandescent light, the arc being 1 m from the photographic plate and the other lamps 40 cm. The photographs indicate that the sunlight was more powerful in the ultraviolet than the rays from any of the artificial sources. The conclusion is, therefore, reached that none of our modern artificial lights needs, under normal conditions, to be protected by absorbent shades, because we do not use screens to cut off the ultraviolet rays in daylight.

Here, then, are two papers, each dependent for their arguments upon spectro-photographs, with directly opposite conclusions. Nevertheless, it seems likely that a middle ground exists that is consistent with the experimental observations in both these papers. It is probable that any excessive stimulus to the retina is injurious, especially if long maintained, and particularly if in the ultraviolet region of the spectrum, where the chemical effect is relatively so powerful. Does anyone doubt that few persons could gaze persistently at the sun on a clear day, near noon, without injuring his eyes? Eagles are said to stare the sun out of countenance; but if they do, their eyes must differ from the great majority of human eyes. Nevertheless, if we hang a naked arc lamp in a concert hall—truly an unpardonable sin, but, nevertheless, occasionally perpetrated—many individuals will stare at it in a sort of hypnotic fascination. The retinal stimulus thereby produced is unquestionably severe. Even if the arc lamp emitted no ultraviolet rays, it is likely that eyes steadily staring at it would in a little while be injured. The ultraviolet rays tend to make matters worse. Nevertheless, once the injury has been done, it is by no means evident that we should attribute the injury to ultraviolet rays. All we can assert is that for a given intensity of illumination, ultraviolet rays are more likely to produce injury than violet rays, and violet perhaps more than green. But the arc lamp has only a small part of its rays in the ultraviolet, compared with the visual rays. All we can safely say is that the injury is due to overstimulus. The same is true in a milder degree for tungsten lamps. If we hang them, unshaded, close by, right in front of our faces, and then absentmindedly stare at them for protracted intervals, we may well wonder if our eyes are not injured. The share of this injury due to the ultraviolet radiation may be relatively small, even if ultraviolet rays are the most harmful for a given intensity of radiation, because only a small share of the lamp's radiation is found in the ultraviolet. The moral of the tale is, therefore, never to place artificial lights in such a manner that even the most stupid person can produce therefrom an excessive stimulus on his retinas by gazing steadily at the brightest points. If we attend to this rule, the ultraviolet rays in artificial light will bother us no more than the ultraviolet rays in sunlight.

Illuminating Engineering Society Convention.

The second annual convention of the Illuminating Engineering Society, to be held in Philadelphia on Monday and Tuesday, Oct. 5 and 6, promises to be a highly successful meeting. It is expected that not far from a third of the members of the society will be in attendance, and of these a large number have indicated their intention to discuss papers, advance copies of which are sent to those who will attend the meeting. Arrangements have been made whereby members will be able to view from points of vantage the more interesting features of the celebration which will be held during the week to commemorate the founding of the city 225 years ago. The program of entertainment also includes a sight-seeing automobile trip and a vaudeville entertainment on Tuesday evening in the ball-room of the Hotel Walton. Following is a program of the papers to be presented:

Address of Welcome. By Hon. John E. Reyburn, Mayor of Philadelphia.

Presidential Address. By Dr. Louis Bell.—A study of the problem of street lighting in its broader aspects, especially with reference to the choice and placing of lamps in their relation to effective illumination.

Report of Committee on Nomenclature and Standards. By Dr. A. C. Humphreys, President Stevens Institute.—An account of the conferences of committees of the Illuminating Engineering Society, the American Institute of Electrical Engineers and the American Gas Institute on the subject of a National Candle Unit, which unit has been formally accepted by the two first-mentioned bodies, and will come up for action in October at the annual convention of the American Gas Institute.

Modern Gas-Lighting Conveniences. By Mr. T. J. Little, Jr.—Describes the various methods of gas-lighting ignition by electrical means, pilot flames, etc., with account of some special gas-lighting fittings and of a small candle-power gas unit.

Illuminating Value of Petroleum Oils. By Dr. A. H. Elliott.—An account of a number of experiments showing the value of petroleum oils as constant sources of light of great reliability, with data of experiments with oils of various densities used in a variety of commercial types of lamps.

Street Lighting Fixtures: Gas and Electric. By Mr. H. Thurston Owens.—Street lighting is divided into five classes, and the methods discussed for securing the best illumination for each class.

Structural Difficulties in Installation Work. By Mr. James R. Strong.—Advocates the laying out of outlets for an office building on the basis not of separate offices, but of each floor as a whole; and for residences on the basis of the darkest probable decoration of rooms, with outlets so located as to admit of any probable changes in arrangement of furniture.

Architecture and Illumination. By Mr. Emile G. Perrot.—The subject is treated under the heads of "Necessary Illumination or Lighting" and "Decorative Lighting," with reference to an example of each case.

Intensity of Natural Illumination Throughout the Day. By Mr. Leonard J. Lewinson.—Gives the result of measurements of illumination from the sun and the moon, the determinations covering the entire range of the 24-hour period and different conditions of weather.

The Integrating Sphere in Industrial Photometry. By Dr. Clayton H. Sharp and Mr. Preston S. Millar.—Treats of the theory of the integrating sphere and gives experimental data on the test and performance of large and small spheres in the photometry of arc and incandescent lamps.

The Ives Colorimeter in Illuminating Engineering. By Dr. Herbert E. Ives.—Describes an instrument for the measurement of all kinds of light in terms of the three primary spectral colors, with a table of readings for all the various sources of illumination.

Calculating and Comparing Lights from Various Sources. By Mr. Carl Hering.—The physical meaning of the various quantities involved in lighting calculations and the laws applying to them are explained, the formulas put in shape for direct practical application, with numerical examples to illustrate their use in calculating and comparing light from different kinds of sources.

The Calculation of Illumination by the Flux of Light Method. By Mr. J. R. Cravath and Mr. V. R. Lansingh.—Practical application of a method suggested by Dr. Clayton H. Sharp whereby the total flux of light is calculated in lumens, and the average illumination of a given plane determined from the number of lumens falling on that plane.

Street Lighting with Gas in Europe. By Mr. E. N. Wrightington.—Describes the various methods of street lighting with gas employed in London, Paris, Berlin, Vienna, etc.

Design of the Illumination of the New York City Carnegie Libraries. By Mr. L. B. Marks.—A preliminary paper treating of the lighting problems involved in the design of the illumination of public libraries, including details of the design of illumination of the Carnegie libraries in New York City.

Engineering Problems in Illumination. By Mr. Alfred A. Wohlauer.—A number of engineering problems in illumination are presented and their solution indicated.

Intrinsic Brightness of Lighting Sources. By Mr. J. E. Woodwell.—Treats of the intrinsic brightness of lighting sources from the hygienic standpoint and discusses the practical application of this factor in the design of illumination.

Some Experiments on Reflection from Ceiling, Walls and Floor. By Mr. V. R. Lansingh and Mr. T. W. Rolph.—An analysis of the effect of reflected light from ceilings, walls and floor—separately and in various combinations—upon the intensity and uniformity of illumination, the analysis being based upon illumination tests of a room equipped with the eight possible combinations of light and dark ceiling, walls and floor.

The Relation Between Candle-Power and Voltage of Different Types of Incandescent Lamps. By Mr. Francis E. Cady.—The paper establishes that the exponent expressing the rate of change of candle-power with change of voltage is not a constant, but a function of the watts per candle; that this exponent is different for different types of filaments, and that its value decreases as the watts per candle decrease.

New York Electrical Show.

The opening of the New York Electrical Show at Madison Square Garden will take place at 8 p. m. on Saturday, Oct. 3, and will be a unique performance, in the fact that the entire exercises will be conducted by phonograph. Governor Hughes, of New York, will open the exhibition in this manner, although at the moment he will actually be speaking in the Presidential campaign hundreds of miles away. Other phonographic speakers will be the presidents of the national and local electrical bodies, and the interspersed music will also be phonographic. The cylinders will be preserved for reproduction in years to come, and one of the records heard on the occasion will be that made by the late Vice-President Hobart in opening the Electrical Show of 1898, just 10 years ago. All the preparations for the show are now complete, and a great success is already indicated. Mr. Edison will open the proceedings by phonograph, thus making his first public speech.

In addition to the general exhibits of the commercial type, special exhibits will be made by the New York Edison Company, the Brooklyn Edison Company, and the United Electric Light & Power Company. There will also be a number of historical, commemorative and other features in charge of an Advisory Board organized as follows: Chairman, T. C. Martin; E. G. Acheson, J. C. Barclay, J. F. Becker, Theo. Beran, John Bottomley, W. W. Bradfield, P. A. Bates, E. Caldwell, George Clapperton, Prof. F. B. Crocker, Minor M. Davis, Dr. C. A. Doremus, Stephen D. Field, Frank H. Gale, Prof. A. F. Ganz, Bancroft Gherardi, Francis W. Jones, T. Inslee Jones, Dr. A. E. Kennelly, Max Loewenthal, Wm. Mayer, Jr., H. K. McCann, J. C. McQuiston, P. S. Millar, W. T. Morrison, Dr. F. A. C. Perrine, A. A. Pope, R. W. Pope, Dr. E. F. Roeber, C F. Scott, Dr. Clayton H. Sharp, Dr. C. P. Steinmetz, L. B. Stillwell, H. G. Stott, P. Torchio, W. C. Webster, W. F. Wells,

G. H. Guy, secretary. This board has been organized into committees, with the following chairmen: Historical Submarine Cable Committee, Dr. A. E. Kennelly; Historical Lighting Committee, A. A. Pope; Electrochemical Committee, Dr. E. F. Roeber; Library Committee, E. Caldwell; Lecture and Educational Committee, Max Loewenthal; Electrical Farm Committee, P. A. Bates; Reception Committee, W. F. Wells. Many of these auxiliary exhibits will be of a most interesting nature, as for example that bearing on the Atlantic Cable of 1858, to which the Metropolitan Museum of Art and the Commercial Cable Company are making splendid contributions. During the exhibition, a number of lectures will be given and meetings of societies will be held; while the proceeds of Thursday, Oct. 8, will be devoted to the Loomis Sanitarium.

Award of Lighting Contract at Turner's Falls, Mass.

A five years' contract has just been awarded for street lighting to the Franklin Electric Light Company of Turner's Falls, Mass., as the result of the report of the special lighting committee of the Turner's Falls Fire District, and in spite of a stiff fight put up by the Greenfield Gas Light Company. The streets of the district have been lighted by means of 4.5 arcs of 1200 cp and 5 incandescents of 25 cp. For these $87.50 was paid for each arc and $25 for each incandescent, a total of $4062.50 per year. The Greenfield Company offered a Welsbach service for five years with 100 or more "improved Boulevard" lamps at $28 per year per lamp of 60 cp. The Franklin Company offered its arcs at $82.50 on a five-year contract and 76 tungsten lamps of 75 watts 60 cp rating. The price for the incandescents being $24 per lamp per year for less than 100 lamps on the five-year basis. In making its report, after a public test of the illuminants, the committee said: "It is evident that the illuminating efficiency of the two lamps (Welsbach and tungsten) is practically the same, while there is a difference between them in price of $4 per lamp per annum, 76 lamps being the least number that can satisfy the requirements of the district. The total difference in annual cost between the two systems is at least $304. Therefore the committee favors the adoption by the district of the 75-watt tungsten lamp. The committee believes a combination system of 16 arcs of the present type and 76 tungsten incandescent lamps of 60 cp. rating, will light the district more satisfactorily than does the present system, at an annual cost of $3144."

In forwarding the data, Mr. W. C. D. Thomas, treasurer of the Franklin Electric Light Company, states that the decision is sustained by public opinion and that the company "won out strictly on the merits of the question."

American Association of Electric Motor Manufacturers.

The fall meeting of the new American Association of Electric Motor Manufacturers took place at Frontenac, N. Y., Thousands Islands, Sept. 9, 10 and 11. During the meeting the following papers were presented, with a view to bringing forth discussion, thus enabling the various committees to incorporate in their reports recommendations for the adoption of uniform practices in the manufacture of electric motors, to the end that the highest quality of electric motors may be made by the members: "Ratings and Guarantees on Direct-Current Motors," by J. M. Hipple, read by W. T. Hensley; "Ratings and Guarantees on Alternating-Current Motors," by C. S. Reno; "Ratings and Guarantees on Variable-Speed Motors for Elevator Service," by W. J. Warder, Jr.; "Freight Traffic," by W. B. Everest.

The various committees appointed at the former meeting have collected considerable information of value for dissemination among the members of the association.

At this meeting, Mr. W. H. Tapley was installed as the permanent secretary of the association, Mr. J. C. McQuiston, who has acted as temporary secretary since the formation of the association, retiring. The association has secured permanent headquarters in the Engineering Societies Building, 29 West Thirty-ninth Street, New York.

The next meeting will be held about the middle of January, 1909. A considerable amount of business was transacted during the three days of the meeting, but time was found, however, on Thursday afternoon, Sept. 10, for recreation, there being three contests, one for golfing, one for bowling and the third for fishing. The golfing trophy, a cup, was won by Mr. Charles Robbins, of Pittsburg; the bowling prize, a silver cup, was won by Mr. W. S. Kemp, of Brookline, Mass. The prize for the largest fish caught, a rod, line and reel, was captured by Mr. F. M. Kimball, of Boston.

With regard to the papers read before the association, it is stated that they were simply presented to the association by the writers for the purpose of bringing forth discussion upon the subjects covered, and that the recommendations made in these are those of individuals, and therefore they have not had any formal endorsement of the association.

Meeting of the Pittsburg Section, A. I. E. E.

The September meeting of the Pittsburg section of the American Institute of Electrical Engineers was held in the lecture hall of the Carnegie Institute. The following officers were elected for the ensuing year: Chairman, Mr. W. Edgar Reed; secretary, Mr. B. P. Rowe; executive committee, Messrs. C. B. Auel, B. Rutherfoord, F. Uhlenhaut, Jr., C. W. Davis, E. B. Tuttle and Ludwig Hommel.

Mr. F. D. Newbury abstracted a paper by Mr. J. L. Woodbridge on "The Application of Storage Batteries to the Regulation of Alternating-Current Systems" (see ELECTRICAL WORLD, page 85, July 11, 1908). The author explained how batteries were used in connection with rotary converters having two-part pole-pieces and also with rotary converters having three-part pole-pieces.

Mr. R. L. Flanders read a paper on the "Relay Type of Load Regulators for Storage Battery Systems," which explained by diagrams how a relay can be used together with a battery to regulate the supply of alternating energy through a rotary converter to deliver direct-current energy satisfactorily.

Mr. P. M. Lincoln said that the ratio of the commutator to the collector ring e.m.f. in a rotary converter is not fixed. The ratios of 1-to-7 for two-phase and 1-to-6 for three-phase do not hold exactly, it being known that by trimming the pole pieces the ratios can be modified. Mr. Woodbridge changes the field form in order to change the ratios. The two-part pole-piece rotary has the advantage of combining the functions of a rotary and a regulator. The disadvantages are that it will probably be more expensive, produce a distorted wave form, the power factor cannot be made unity, while the conditions are favorable for resonance with large cable systems and also favorable for hunting.

Mr. J. L. Davis discussed a paper by Prof. Fessenden on "Wireless Telephony." (See ELECTRICAL WORLD, page 401, Aug. 22, 1908.) He explained that the energy began to flow out into space from the antenna harp when the frequency became 85,000, and from that on to 100,000 the energy radiated increased from 0 per cent to nearly 100 per cent. He also explained the design of a high-frequency generator, the arrangement of Poulsen's arc and the marginal method of tuning invented by Fessenden.

Mr. E. B. Tuttle spoke of the method of relaying telephone messages from wire lines to wireless transmitters and vice versa.

Mr. S. P. Grace, in the discussion, spoke of the progress made in telephony. He started with the first form of telephone, that of iron rods driven into the ground outside of forts to indicate to the defenders any attempt of an enemy to tunnel into the fort, and showed the rapid progress that has been made in the art. He referred to some early letters on the invention of the telephone written by Mr. T. A. Edison to Mr. T. B. A. David.

The Ontario Hydro-Electric Power Commission at Ottawa.

By J. A. Macdonald.

The Ontario Power Commission thus far has only begun operations, so to speak. It is now engaged in building trunk lines through Western Ontario in order to furnish the towns in that district with cheap power from Niagara.

Ottawa, however, happens to be the one place where the commission has thus far made a contract which is actually in operation. It is, therefore, held to furnish an illustration of what Toronto and other cities may expect when the contracts which the Hydro-Electric Commission is now making are put into operation. Hon. Adam Beck, chairman of the commission, asked the municipal authorities of Ottawa for an expression of their experience with Hydro-Electric Power Commission power, and a letter, signed by the Mayor and the secretary of the Ottawa Municipal Power & Light Company, was sent to Hon. Adam Beck, of which the following is a summary of some of the more important points dealt with. It will be seen that the city has greatly benefited by the Government's power policy.

Before the arrangement with the Hydro-Electric Power Commission, Ottawa was paying 15 cents net per kw-hour for light, $40 and up per horse-power for power and $65 per arc lamp for street lighting. After the arrangement, they now pay 7 1-5 cents net per kw-hour, $25 per horse-power for power and $45 per street arc lamp. Before they had 1200 customers, with a revenue of about $35,000, no profit, and about 800 hp unused. Now there are 3000 customers, $100,000 revenue, $10,000 profits and 2300 hp used.

Without the intervention of the commission the city would have been out $250,000 spent on a distributing plant, and the people would have had to pay at least $100,000 a year more ($1.25 per capita) than they are now paying for their light.

Everybody in Ottawa is satisfied and will do his best to make the present conditions permanent. The people are satisfied because they are saved a large increase in rates and are ensured reasonable ones. The Ottawa Electric Company is satisfied because it can pay its way and earn dividends, and is assured of the situation. No one in Ottawa desires to change the present conditions. The city council cannot unduly increase the rates, because they are subject to revision by the commission. With this safeguard, the electric situation now in Ottawa is ideal.

Ratings of Electric Motors.

At a meeting of the American Association of Motor Manufacturers, held at Frontenac, N. Y., Sept. 9-11, a paper by Mr. J. M. Hipple, of the Westinghouse Electric & Manufacturing Company, dealing with ratings and guarantees on direct-current motors, was read by Mr. W. T. Hensley. The author suggested that the temperature rise of all parts except the commutator measured by thermometer should not exceed the following values for constant-speed and adjustable-speed continuous duty: Open type, 45 deg. C. for all machines smaller than 2 hp, and 40 deg. C. for larger machines; semi-enclosed, 50 deg. C.; enclosed, 55 deg. C. For adjustable-speed intermittent duty the temperature rises should not exceed the following values: Open type, 45 deg. C.; semi-enclosed type, 55 deg. C.; enclosed, 55 deg. C. The commutator can be allowed 5 deg. C. greater rise in each case. The temperature rise of varying-speed motors should not exceed 55 deg. C., the maximum commutator rise being 60 deg. C.

Mr. Hipple proposed that the temperature guarantee be considered of prime importance in determining the size of motor to be used for various classes of service. With the present lines of motors there is no doubt that commutation frequently limits the rating of the motor. "The direct-current motor builder is forced to admit privately, if not publicly, that the constant-speed alternating-current motor has, to a considerable extent, supplanted the direct-current motor for constant-speed work. Fortunately, however, there has been a steady growth in the use of direct-current motors on machine tools, elevators, hoists, in mills, and in many special applications. The development of motors to meet these requirements has brought about the revival and perfection of the commutating pole which has practically eliminated the commutation limit for ordinary speeds and voltages. Guarantees, which are to hold for future years, must be based primarily on the temperature whether for adjustable-speed or constant-speed work. If commutation proves in the end to be the limit with the non-commutating pole motor, it seems probable that the commutating-pole motor will be more generally used in all classes of service."

Mr. C. S. Reno, of the Triumph Electric Company, Cincinnati, presented a paper discussing the ratings and guarantees on alternating-current motors. He expressed the opinion that all induction motors should be rated so that when run continuously at the specified full-load output the temperature rise of any part shall not exceed 40 deg. C. by thermometer or 55 deg. C. by the resistance method. The allowable maximum temperature rise under 25 per cent overload should be 60 deg. C. In discussing the guarantee clause which states that the manufacturer must insure the successful operation of a motor for one year, Mr. Reno said that some concerted action should be taken by the motor manufacturers to protect themselves from expenses for which they are not justly liable, such as those caused by damage due to abuse or neglect.

A paper by Mr. W. J. Warder, Jr., of Roth Brothers & Company, Chicago, dealt with direct-current motors for elevator service. He claimed that the maximum temperature rise under operating conditions should not exceed 40 deg. C. on the windings and core and 45 deg. C. on the commutator. The slow-moving freight elevator with long stops for loading and unloading represents one extreme. The fast passenger elevator in the busy office building represents the other. Vastly different windings may be made to obtain the same temperature rise under these varying conditions. If the limiting temperature rise is not approximated the motor is not best adapted to its work and a more economical equipment could be made. Since operating conditions cannot easily be duplicated for testing purposes, it becomes desirable to establish standard lengths of run at the end of which the limiting temperature rises are not to be exceeded. For slow freight service, motors attaining the limiting temperature rise in one-half hour have been found satisfactory. For ordinary passenger service the time must be increased to one hour, and for fast passenger, although one-hour ratings are sometimes used, there are many cases which require two-hour ratings. In the case of auxiliary-pole adjustable-speed motors the limiting temperature rise may be reached in one hour when operating at minimum speed, and in two hours when operating at maximum speed. Windings which are used for starting only may be proportioned to give the limiting temperature rise in one-fourth hour. Success has attended the use of starting windings which reached the limiting temperature rise in five minutes. In such cases the condition of operation must be accurately known.

The commutating conditions during the running period and at starting must be such that little attention will be required of the commutator. The detrimental effect of the overload at starting is counterbalanced by the fact that the average load is usually from one-half to one-third the maximum for which the motor is rated. This means that the full-load commutating conditions must be about as good as for standard continuously-running motors. Naturally, in regard to commutation the auxiliary-pole motor offers advantages equal in importance to its superior torque characteristics.

The author stated that the horse-power required to drive an elevator is determined from the net load lifted, the speed and the efficiency of the mechanism. The efficiency may usually be taken at 60 per cent. When the construction is of the best quality 70 per cent may be obtained, while in many cases it will fall as low as 50 per cent.

Electricity in the Textile Industry.

At a meeting of the National Association of Cotton Manufacturers, held at Saratoga Springs, N. Y., on Sept. 29-30, Mr. Lewis Sanders presented a paper entitled "The Textile Mill Power Plant," in which he advocated co-operation among mills to the extent of installing a central generating station for supplying energy to all mills in certain localities. The greatest single advantage attending the use of this method would be the freeing of the mill management of all work in connection with the generation of energy and permitting it to concentrate its entire time on the production of goods. The generating station could be given the highest grade of management and at less cost per plant than at present. Many economies could be effected in repairs, and in the purchase of coal, supplies and new equipment on account of the combined purchasing capacity of the many plants. Mr. Sanders stated that in many cases the increased output obtained from an electrically-driven mill, as compared with the older belted mills, will warrant the change to electricity, although the actual saving in cost of energy may not justify the investment for electrical equipment. When electricity is used, each machine may be driven continuously at its maximum permissible speed, giving an increased output without any increase in machinery or operators, and possibly with less expense for repairs.

The Newest Incandescent Lamps.

At the Colorado Electric Light, Power & Railway Association convention at Glenwood, Colo., in September, Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, read a paper on the "Newest in Incandescent Lamps," which relates principally to "Meridian" tungsten lamps, of which two types—40-watt and 80-watt—have been placed on the market. While the Gem "Meridian" lamps were designed for increased spherical candle-powers, the tungsten "Meridian" lamps have enabled the manufacturers to decrease the total wattage consumed, to increase greatly the spherical candle-power, to better the candle-power maintenance and to give longer life.

The progress of the "Meridian" lamp to date is indicated by the following data:

	Meridian No. 1			Meridian No. 2		
	Mean Spher. C. P.	Total Watts	Life	Mean Spher. C. P.	Total Watts	Life
Carbon	13.8	60	600	26.7	120	600
Gem	16.0	50	500	32.0	100	600
Tantalum	16.0	40	600	32.0	80	600
Tungsten	25.6	40	800	37.4	60	800

The filaments of the new tungsten "Meridian" lamps are made in five loops, instead of four, as in the two other styles of tungsten lamp of these approximate sizes. The lamp is made with a skirted base, which fits the ordinary socket. The skirt is so insulated from the base that, when the lamp is in place, no metal carrying current is exposed. The filament is composed of five simple loop or hairpin filaments arranged in series. The filaments are supported in such a way by small wires sealed into a central glass supporting member, that the lamp can be satisfactorily operated in any position without the filaments sagging, so as to short circuit one another.

Both the "Meridian" No. 1, of 40 watts, and the "Meridian" No. 2, of 60 watts, are made for voltages from 100 to 125. They operate on their rated voltage at 1.25 watts per candle (mean horizontal in a clear bulb), but as there is not, at present, absolute uniformity in the lamps of certain specified ratings, the lamps vary in total watts. For example, the 40-watt lamp, as commonly rated, may vary between the limits of 35 and 45 watts; the 60-watt lamp, from 50 to 70 watts. The useful and total lives of these round bulb lamps are in excess of 800 hours, when burned at the rated 1.25 watts per horizontal candle. The lamps operate with equal life upon either alternating or direct current circuits and when inclined at any angle or in a horizontal position. The efficiency remains practically constant throughout the life of the lamp.

The Westinghouse Nernst Lamp.

Mr. A. L. Eustice, illuminating engineer of the Nernst Lamp Company, at the convention of the Colorado Electric Light, Power & Railway Association at Glenwood, Colo., in September, read a paper on the "Westinghouse Nernst Lamp; Its Value as a New Business Getter for Central Stations," which brought out some technical data on the recent improvements in Nernst lamps. The new Westinghouse Nernst lamp embodies a gain in efficiency over older types, a great variety of sizes, the application of the lamp to 110-volt service, and a simplification of maintenance.

The various types of units and the service to which they are adapted are shown in the following:

Lamp.	Voltage.	Current.	Service.
1-glower (66 watt)	110	.6	a.c. and d.c.
1-glower (88 watt)	220	.4	a.c. and d.c.
1-glower (110 watt)	110 and 220	1.0 and .5	a.c. and d.c.
1-glower (132 watt)	110 and 220	1.2 and .6	a.c. and d.c.
2-glower (264 watt)	220	1.2 (X)	a.c. and d.c.
3-glower (396 watt)	220	1.8	a.c. and d.c.
4-glower (528 watt)	220	2.4	a.c. and d.c.

All multiple-glower, 220-volt type, alternating-current lamps can be operated from 110-volt service by use of a small converter coil. The new lamps have no unsightly exposed terminals. The new wafer heater makes it possible for the heater to be changed without skilled labor and without disturbing any other part of the lamp. The four sizes of single-glower lamps are of the Edison base type. The cut-out is located within the base. The holder, which is renewable in the same manner as the incandescent lamp, consists of a glower and a wafer heater permanently connected on a piece porcelain provided with a standard screw base, with an additional contact pin in the center. By an assortment of diameters and lengths of contact pin it is impossible to insert any other than the proper holder in the lamp body, thereby insuring the consumer against troubles from the use of lamps of various sizes and voltages. This form of renewal is called the screw burner and should supply the demand for a high-efficiency lamp so rugged in design that it can be maintained by anyone. Renewals can be secured in small packages by mail or in large shipments by freight.

The glower has been improved mechanically and electrically. A new terminal design materially reduces the terminal losses due to the Peltier effect and, therefore, provides a longer lighting length between the terminals for the same voltage. The addition of certain radio-active materials in the glower itself results in a more uniform candle-power performance and the combination of the above features gives a great advance in individual glower life. While the average life performance of the glower has, in the past, exceeded the manufacturer's guarantee, yet comparatively early failure of the glower was not infrequently met.

A summary of the life of the various elements is given below. These figures are the basis of the standard guarantee given on any installation of over 100 units for the average life performance when operated on a circuit whose regulation is within 5 per cent above or below the normal point of operation.

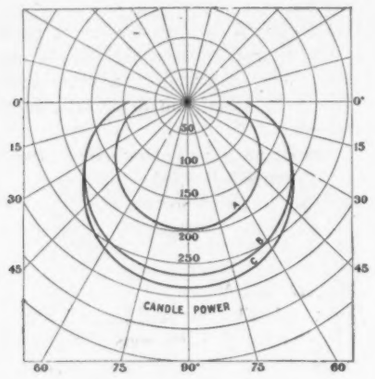
	Hours Life							
	Direct Current.		Alternating Current.					
			25-Cycle.		60-Cycle.		133-Cycle.	
Part.	110 V.	220 V.	110 V.	220 V.	110 V.	220 V.	110 V.	220 V.
Glower	....	600	....	400	....	800	....	800
Heater	....	3,000	....	3,000	3,000	3,000	3,000	3,000
Ballast	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Screw burner.	600	600	400	400	800	800	800	800

The consumption of the various sizes of the new lamp are given as follows: 66-watt, 1.38 watts per mean hemispherical candle-power; 88-watt, 1.2 watts per mean hemispherical candle-power; 110-watt, 1.2 watts per mean hemispherical candle-power; 132-watt, 1.2 watts per mean hemispherical candle-power; 2-glower, 1.2 watts per mean hemispherical candle-power; three glower, 1.15 watts per mean hemispherical candle-power; 4-glower, 1.09 watts per mean hemispherical candle-power. These figures are for lamps with clear glass globes.

In the accompanying illustration, curve *A* shows the distribution of light from an old type 3-glower, 264-watt lamp. Curve

B is for a 4-glower, 352-watt, old type lamp. Curve *C* is for a lamp of the 2-glower, 264-watt, new type. White alabaster globes were used in each of these tests. A comparison of curves *B* and *C* shows the improvement in efficiency.

A new line of Nernst fixtures is being designed with the ballasts and cut-outs in the body of the fixture and the glower

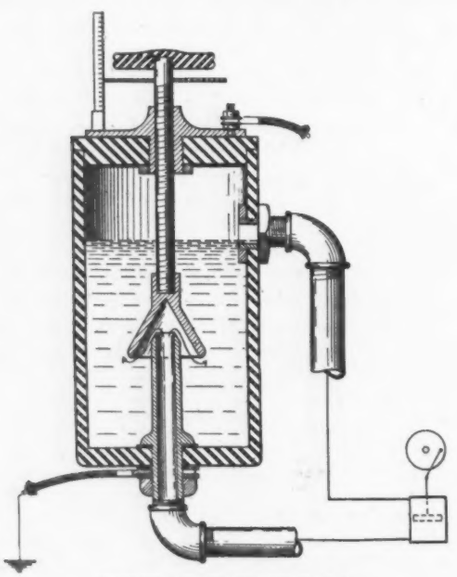


DISTRIBUTION OF LIGHT.

and heater globes in various positions at angles or upright around the fixture. This makes possible a design of fixture not limited by the necessity of placing the glowers horizontally as in the other types where the position of the cut-out makes it necessary to hang the lamp in a vertical position.

Oil-Insulated, Gap-Type Lightning Arrester.

The accompanying illustration shows a form of lightning arrester the spark-gap of which is insulated by means of oil kept continuously in circulation. The device is arranged to provide a weak spot in the insulation of the line which will break down and relieve the accumulated electrical pressure whenever the latter becomes dangerous, and which will immediately reëstablish the insulation after the pressure has been



HANCHETT-SHAW ARRESTER.

reduced to the normal line value. The gap is formed between a bell-shaped electrode and the end of a pipe through which oil is forced. The distance between these two terminals, which are separately insulted, is adjustable so that the arrester may be arranged to discharge at any desired e.m.f. A patent for this arrester was granted to Messrs. G. T. Hanchett and H. M. Shaw on Aug. 11.

American and European Street Lighting.

By Dr. Louis Bell.

Speaking in general terms, American cities are at least as enterprising in public improvements as are foreign cities of similar size, but home enterprise is sometimes misdirected, and in certain particulars European municipal activity produces, as a matter of fact, results that are seldom even approximated in American cities. The two things that impress the traveler most forcibly as being better done abroad than at home are street cleaning and street lighting. In the case of the former there is no need in the present article to analyze the situation, but merely to say that a comparison of conditions is far from flattering to our national vanity.

In the matter of street lighting the contrast is quite as sharp, but it reaches below methods and apparatus and touches the fundamental conceptions as to the purpose and definition of street lighting. The American idea, as it would be judged by an observing foreigner, is to display conspicuous illuminating devices over as large an area as practicable, regardless of average illumination and of local requirements, all streets, so far as the available funds allow, being treated very much alike. Of course, in sparsely populated districts where voters are few, lights are also few, but the scheme of approximate equality is in the main carried out. A street on these principles would be defined as lighted whenever a succession of brilliant luminous sources is visible to the wayfarer. Central-station men have long understood the faults of the system, and have done their best to remedy them, but they have been always confronted by the difficulty that the general public never having seen really first-class street lighting, neither appreciates its importance nor realizes its practical value.

The best the central-station man has been in most instances able to do is to give good service with the lights which he is directed to install and to hope for better things. When more lights are added they commonly serve merely to increase the large area already dotted with infrequent luminaries. The result is that in any American city there are a large number of streets fairly even in the mediocrity of their illumination, as many more on which the lighting is less pretentious, but not very much less effective, and a remainder in which the lights are hardly more than markers to point out the direction of the roadway.

The situation in the average European city is radically different in theory and practice. In the first place a small group of chief streets is selected in which the actual illumination is made both very even and very brilliant. These streets are those in which there is great activity after nightfall, and which are the main avenues of evening traffic. Such streets are nearly always lighted with closely spaced and powerful arc lamps, always in opal globes to check the fierce glare of the naked arc and to give more uniform diffusion of the light, hung high on iron or bronze poles, or very often carried on cross-suspensions. There is not only enough light to see by, but to read a newspaper by, all up and down these first-class streets. Outside of this group the illumination is fairly good, and while more uniform, is less brilliant than in the best lighted American streets. Beyond these, especially in suburban territory, there are streets in which the lights are only markers. The European subsidiary streets are lighted either by smaller or less frequent arcs than the chief streets, by Auer burners, or in rare instances by Nernst or ordinary incandescent lamps. The important streets of a European city have a class of lighting service entirely unknown in this country, save in a few short stretches mainly installed as exhibits within the past year. It is, nevertheless, a class of lighting that is badly needed in our larger cities and which is easily secured if desired. The fundamental requirement is merely a very moderate expenditure of energy instead of a ridiculously small one. What sort of illumination can one expect to get from an expenditure of only two- or three- hundredths of a watt per square foot? Yet this is more than the ordinary important American street is allowed to receive. It has from less than 20 to possibly 30 arc lights per mile, gen-

erally taking less than 10 kw per mile, and seldom or never more than 15 kw, and these arcs are commonly of the enclosed type giving a scant half candle-power per watt. Until energy is more literally supplied, one has no right to expect anything more than an apology for illumination.

A similarly important European street would show 40 to 50 arcs per mile, taking more energy per lamp and giving a better luminous return for the energy. With 20 kw to 30 kw per mile of a street, particularly when utilized as it is more and more coming to be in flaming arcs, brilliant lighting is easy. To put the results very conservatively, the general illumination in a first-class foreign street is apt to be 5 to 10 times as strong as in our streets here. We talk meekly about specifying, say, 0.03 foot-candle, measured on the normal to the ray, as a suitable minimum illumination between lamps, and point with pride to lamps specialized to give that minimum with the least practicable average. In London 0.1 foot-candle *measured on the horizontal,* the irreducible minimum advised, and in the recent installations of flame arcs this figure is generally considerably surpassed. In these installations the arcs—flame arcs at 550 to 600 watts—are hung perhaps 40 yd. apart, and similar practice is the usual thing on the Continent with similar results. Briefly, the foreign municipal authorities expect and get tenths of foot-candles, where we find hundredths in the chief streets of the city. It must not be for a moment supposed that this discrepancy is the result of cheap electric lights abroad. Quite the contrary. London pays on the average more than $100 per arc per year, Paris $166, Berlin very nearly $120, and the average price for current is very generally higher than here. The fact is that it is considered wise and good citizenship to see that the streets where lights are most needed are most liberally supplied. The effect of such lighting on public order and the prevention of crime must be great, and it would be still greater here where crimes of violence seem to be on the rapid increase. The American city needs to double the energy allotted to the lighting of its most important streets, and to increase the number and power of its lights all along the line, to forget the pitiful minima often specified, and to insist upon having illumination by which people can actually see.

The writer has sometimes sinned in the past by joining the procession of shuffling apologists willing to put up with so-called "standard" practice in street lighting; in the future he proposes to stand uncompromisingly for adequate illumination, such as is now in this country hardly more than accidental. It is not creditable to American cities that they have not undertaken reform in lighting ere this. They come out strongly for lower prices, but are weak on general improvement in results. What is needed, just now, is work intensive as well as extensive—improving the lighting of the principal streets, as well as stringing occasional lamps in half-built suburban roads. We have, in this country, the enterprise, the money and the engineering skill to make American cities the cleanest, best paved and best lighted in the world, and the work of improvement ought to be started without further delay.

CURRENT NEWS AND NOTES.

ELECTRICITY IN RUSSIA.—The Russian Minister of Finance has declared his intention of assessing a tax on electrical energy, which will yield a revenue, it is said, of about $4,500,000 a year to the treasury.

THE WASHINGTON MONUMENT.—It is reported from Washington that President Roosevelt has decided not to give permission for the installation of a wireless telegraph system on the Washington Monument, which is the highest point at the National capital.

MAGNETIC CLUB CELEBRATION.—The twentieth anniversary of the Magnetic Club of New York will be celebrated at the regular fall dinner to be held at the St. Denis Hotel, Broadway and West Eleventh Street, Nov. 18. On that occasion the club will have as its guests the delegates of the Telegraphers' Mutual Benefit Association.

ELECTRIC RAILWAY CONVENTION.—The Central Railroad of New Jersey has arranged to give special attention to passengers to and from the street railway convention, to be held at Atlantic City, Oct. 12-16. Round-trip tickets are good for six months, with no extra charge for return via Philadelphia.

BERLIN ELEVATED ACCIDENT.—A special cable dispatch from Berlin, of Sept. 26, says: "Two trains on the Berlin Elevated Electric Railroad were in collision early this morning. Eighteen persons were killed and many injured. The accident was caused by a mistaken signal. One of the cars, which was crowded with passengers, was thrown to the street 40 ft. below. It was shattered beyond recognition. The greatest mortality was in this car." Some of the passengers are reported to have been killed by shock from the third-rail.

WALLINGFORD MUNICIPAL PLANT.—The Wallingford (Conn.) Borough Electric Works have made their annual report for the year ending July 31, 1908. The gross income was $27,877 and the operating expenses were $19,067. The bulk of the income was $21,158 from commercial business. The investment is put at $82,652, on which depreciation is allowed at 5 per cent, making $4102. A profit is figured at 5 per cent of the same amount. The total gain for 1907-8 above legal requirements is placed at $144. The system has added a day service during the year by installing a water-power plant at Quinnipiac.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION.—The Northwest Electric Light & Power Association was organized Sept. 19 at Seattle, Wash., by the electric light interests of Oregon, Washington and Idaho after two years of effort. The association is composed of about 75 members, of which Arthur Gunn, of the Wenatche Electric Light Company, is president, and J. D. Crary, of Aberdeen, temporary chairman. The organization will bring together about 200 of the foremost electric lighting men of the Northwest. On Sept. 19 the members were the guests of the Seattle Electric Company. The first meeting was concluded with a banquet at Hotel Butler in the evening. The next meeting will probably be held in Seattle in 1909.

OLD TIME TELEGRAPHERS' REUNION.—The Old Time Telegraphers' and Historical Association held its annual reunion at Niagara Falls, Sept. 16, 17 and 18. There was a good attendance. Officers for the ensuing year were elected as follows: E. B. Saylor, of Pittsburg, president; C. E. Bagley, of Pittsburg, and W. J. Camp, of Montreal, vice-presidents; F. J. Scherrer, of New York, secretary and treasurer, vice John Brant, deceased. The society of the United States Military Telegraph Corps, which held its meeting at the same time and place, elected these officers: Col. W. B. Wilson, of Philadelphia, president; W. L. Ives and C. A. Tinker, of New York, vice-presidents; David Homer Bates, of New York, secretary and treasurer. The next annual joint meeting of the two societies will be held at Pittsburg next year, at a date to be fixed later.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The season of professional meetings of the American Society of Mechanical Engineers will be opened on Tuesday evening, Oct. 13, by a meeting of the Gas Power Section in the Engineering Societies Building, New York. Mr. H. L. Doherty, chairman of the meetings committee of the section, will present a report for discussion outlining plans for future work and there will also be a discussion of standards to be used in gas power work. Two papers will be read, one by E. A. Harvey on gas producer plants, with data upon costs, performance, etc.; and one by N. T. Harrington, giving the results of tests to determine the loss of fuel weight in a freshly charged producer, due to increase of ash contents in the fuel bed. The first paper will be illustrated by lantern slides, showing actual plants and plans for the arrangement of apparatus.

DROUGHT IN NEWFOUNDLAND.—The recent prolonged drought has made its disastrous effects felt all along the Atlantic coast. A special telegram from St. Johns, Newfoundland, of Sept. 26 says: "This city has been without electric light and street railway service several times during the last two weeks, because of the failure of the water supply. The drought has caused considerable hardship throughout the colony, and many of its manufacturing and other industries have been forced temporarily to cease operations owing to the lack of water power."

GOVERNMENT PRINTING OFFICE.—The U. S. Civil Service Commission will hold an examination on Oct. 28-29 to secure an employee to take charge of the buildings division of the Government Printing Office, Washington, at $2500 per annum. Knowledge of electrical matters—motors, lights, telephones, etc.—has a bearing on the eligibility of the candidate, and persons with technical degrees will be given preference. The total experience should cover a period of five years. The age limit is 25 to 50. Details can be obtained from the Commission in Washington.

TUNGSTEN AS A METAL.—According to the report of the U. S. Geological Survey, the demand for tungsten ores and products during the first nine months of 1907 was much greater than that of 1906, prices were high, mining and prospecting were both actively carried on, and as a result the output of the United States was increased from a total of 928 short tons of concentrates carrying 60 per cent of tungsten trioxide in 1906 to 1640 short tons in 1907, while the value rose from $348,867 in the earlier to $890,048 in the later year. The output of Australasia was 1643 tons. Tungsten is of widespread occurrence but the individual deposits are not usually large.

SONS OF JOVE.—The sixth annual meeting of the Order of the Rejuvenated Sons of Jove will be held Oct. 14, 15 and 16 at the Hotel Iroquois, Buffalo, N. Y. The preliminary proceedings will include a badger fight and some less serious business. On Thursday, Oct. 15, a special train will take the convention to the Roycrofters, at East Aurora, when Elbert Hubbard will deliver an address in the chapel and lunch will be given at the phalanstery. The same day, after incidental business, there will be an illuminated Jovian parade in Buffalo with marvelous electrical effects, fireworks, victims and the police, followed by a grand rejuvenation at the cathedral of the Scottish Rite Masons and a Dutch lunch. On Friday there will be another lunch; and "unfinished business," election of officers, and a banquet will receive attention in due sequence.

PENNSYLVANIA ELECTRIC ASSOCIATION.—The full list of officers of the new Pennsylvania Electric Association is as follows: President, L. H. Conklin, general superintendent, West Penn Electric Company, Connellsville, Pa.; vice-president, E. F. McCabe, superintendent, Mifflin County Gas & Electric Company, Lewistown, Pa.; secretary and treasurer, E. L. Smith, president, Towanda Electric Illuminating Company, Towanda, Pa.; executive committee, A. R. Granger, manager, Beacon Light Company, Chester, Pa.; E. A. Fichthon, secretary and treasurer, Metropolitan Electric Company, Reading, Pa.; C. H. Orr, general superintendent, Allegheny County Light Company, Pittsburg, Pa.; J. H. Perkins, manager, Wilkes-Barre Gas & Electric Company, Wilkes-Barre, Pa. As already announced, this body has voted to become affiliated with the National Electric Light Association.

AMERICAN ELECTROCHEMICAL SOCIETY.—At a meeting of the board of directors of the American Electrochemical Society, held Sept. 26, in New York City, favorable action was taken on the applications of 61 electrical engineers for membership in the body. These applications were the gratifying result of the circular-letter sent out recently by the membership committee, calling attention to the society, and the large promise of its field of development, and the necessity for progressive electrical engineers to become acquainted with it. President Acheson is deeply interested in this work of building up the society, and points out that in accordance with the by-laws, no dues for the present year are now payable by those making application for membership except in the event of their wishing to secure the society's transactions for this year. They will, however, receive the monthly bulletins.

DROUGHT IN VERMONT.—For over a month Vermont has been without rain, and many lighting and power plants have suffered. With regard to the recent statement that the Montpelier Consolidated Lighting Company was obliged to shut off its power entirely, owing to low water, President J. E. Davidson writes us as follows: "It is true that we are having a serious drought here and to-day, Sept. 21, are carrying but 500 kw from our water-power plant. Nevertheless, we have a steam auxiliary plant which will take care of 3500 hp of our power load, which is all but 500 kw of the entire load. This is divided up among the plants by shutting certains ones off once a week. We have not had any interruptions in our lighting service or any service after 4 p. m. In an ordinary drought we have ample steam capacity to carry all of our load, but as this is so exceptional we are obliged to fall down partially. Still our customers are co-operating with us, and it is not as bad as it might be."

AMERICAN WATER POWERS.—In connection with the preparation of a report for the Conservation Commission recently appointed by the President, the United States Geological Survey has undertaken to make a complete census of the water powers of the country, including data as to the amount of power that is now developed on the various streams and the amount available for future utilization. A somewhat similar work was undertaken in 1880 in connection with the Tenth Census of the United States, as a result of which two volumes on the subject, one relating to streams east of the Mississippi and the other to Western streams, were published. Since the preparation of that report an immense amount of information in regard to surface water resources in various parts of the country has been collected by the United States Geological Survey, and this information, embodied in the Survey records, serves as a basis for the present census. The work of preparing the census is divided among nine hydrographic districts, each under the charge of a district engineer, who, with a corps of of trained assistants, devotes his entire time to studying the conditions affecting stream flow in the group of States assigned to him.

EMPIRE STATE ASSOCIATION.—The Empire State Gas & Electric Association will hold its fourth annual meeting on Oct. 7 at the United Engineering Societies Building, New York City, wh n a number of important topics will be discussed. Mr. R. M. Searle, of Rochester, will read a paper on the "Public Policy Work of the Association" and Mr. C. H. B. Chapin, secretary, will present a review of the opinions and decisions of public service commissions. Mr. T. R. Beal, chairman, will present the report of the taxation committee and a paper on "The Taxation of Gas and Electric Companies in New York." Mr. Hugh T. Wreaks, of the Wire Insurance Bureau, will read a paper on "Insurance," and Mr. Henry Floy a paper on "Regulation of Electric Service by Commissions." The new constitution will also be considered, and the important question of affiliation with the national associations. Luncheon will be served at 1 p. m. in the Engineers Club, adjoining. The association will attend in a body the Electrical Show, where special facilities will be provided for central-station representatives. An unusually large attendance is expected, not only on account of the growth of the association and of the lighting industry in New York, but because of the attractiveness of the exhibition at Madison Square Garden.

Recent Power Plant Development of the Brockton Edison Company.

THE Edison Electric Illuminating Company, of Brockton, Mass., has lately placed in service a new 3000-kw steam turbine generating plant which supersedes the original station of the company in the business center of Brockton. The new plant is located in the town of East Bridgewater, and it is connected with Brockton by a 13,200-volt transmission line, comprising two three-phase circuits seven miles long. Adjoining the old plant at Lincoln, Montello and School Streets, Brockton, is a receiving and distributing substation equipped with transformers and rotary converters for supplying energy to the local service. The new power plant and substation were designed and built by Westinghouse, Church, Kerr & Company, of New York City.

The original station in Brockton is still held in readiness for emergency service, but it is not expected that it will be necessary to operate it except on rare occasions. This station was one of the oldest Edison plants in the State, and up to eight years ago contained 24 small high-speed belted generators. In later years the station equipment comprised direct-connected units, but its size and general arrangement were not large and flexible enough to enable it to meet the demands on the company's service. The old plant has now available for service one 300-hp and seven 150-hp horizontal return tubular boilers, of Bigelow & Kendall manufacture, capable of operating at 130 lb. steam pressure. These are provided with a brick stack 6 ft. in

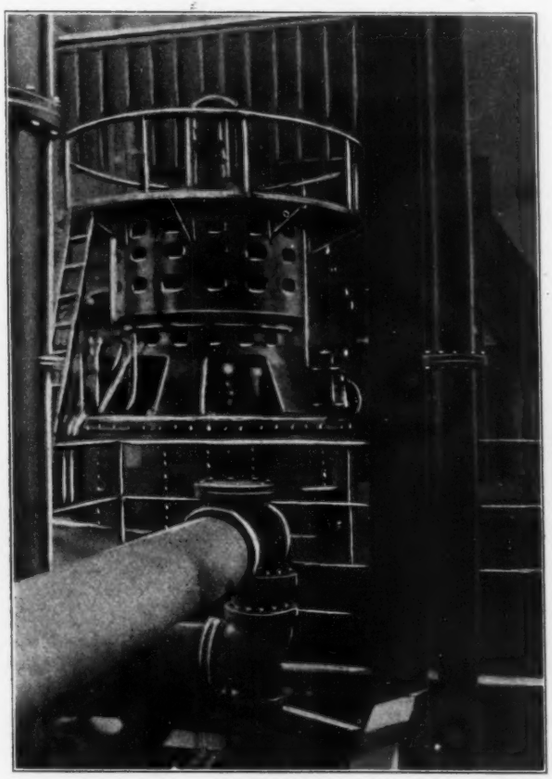


FIG. 1.—1500-KW TURBO-GENERATOR SET IN EAST BRIDGEWATER STATION.

diameter and 115 ft. high and a steel stack 4 ft. in diameter and 80 ft. in height. City water was used for boiler-feed purposes in this station, and all the engines in it are run non-condensing. The coal storage on the premises is only 50 tons, but at a yard about half a mile away 1500 tons can be stored. The following generating units are ready for emergency operation: One McEwen engine direct-connected to a 250-kw, two-phase, 2200-volt General Electric alternator; one McEwen engine direct-connected to a 400-kw General Electric 2200-volt alternator; two McEwen engines each direct-connected to two 100-kw, 125-volt General Electric, three-wire, direct-current generators; one Armington & Sims engine belted to two 50-kw, 125-volt Edison bipolar machines; one Armington & Sims engine belted to two 50-kw Edison machines, and one Armington & Sims engine belted to two 25-kw Edison machines and one 75-kw, two-phase Westinghouse 2200-volt alternator. The old station is located within 400 ft. of the center of low-tension distribution and is connected to the new substation in the adjoining building by tie lines.

The new station at East Bridgewater is designed to allow for progressive enlargement on the unit principle. The plant is

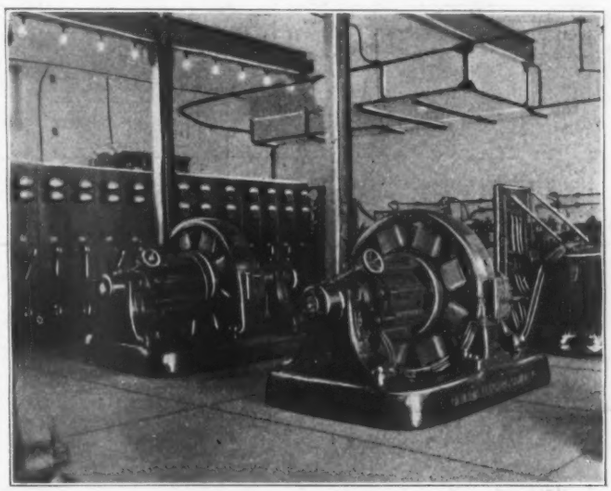


FIG. 2.—INTERIOR OF BROCKTON SUBSTATION.

situated on property bordering on the Matfield River, which supplies the feed and condensing water for the station. The station building is at present about 130 ft. long by 45 ft. wide, and is a brick and steel structure with concrete foundations. All portions of the station interior are well lighted by windows of the horizontal axis type. On the west side of the building is a steel stack, 230 ft. high, lined with brick to an inside diameter of 10 ft. Natural draft is used in the plant.

Coal is brought to the station in cars, which are run alongside

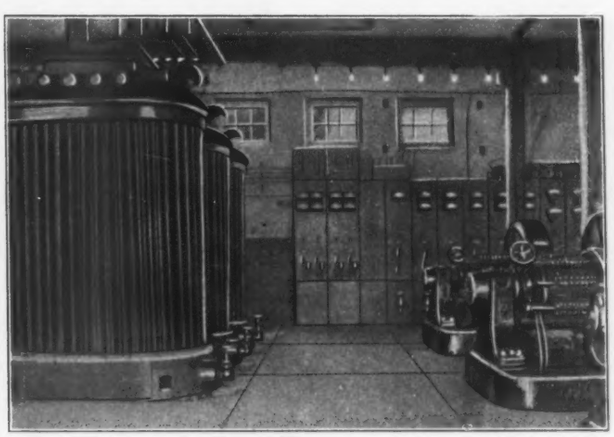


FIG. 3.—TRANSFORMERS IN BROCKTON SUBSTATION.

the boiler room wall on a wooden trestle from which the fuel is dumped. The plant is designed so that when required coal bunkers can be built above the boilers, but at present the coal is brought into the boiler room by a car of 1600-lb. capacity which is hauled up an incline on a 24-in. gage track by a 10-hp, 220-volt induction motor fitted with a rope pulley, snatch block and idlers. The New River coal used is weighed at the top of the incline before being fired by hand into the furnaces.

The turbine and boiler rooms, which are separated by a 13-in. wall, are provided with basements, where are located, re-

spectively, the condensing machinery and ash-handling equipment. All the condensing apparatus is accessible from the turbine room. The output of the turbines is controlled from a switchboard located at the south end of the turbine room, with a gallery for the outgoing line and lightning arrester connections. Expansion of the station will take place on an east and west axis, the boilers and turbines being set in parallel rows, with individual condensing equipment for each turbine.

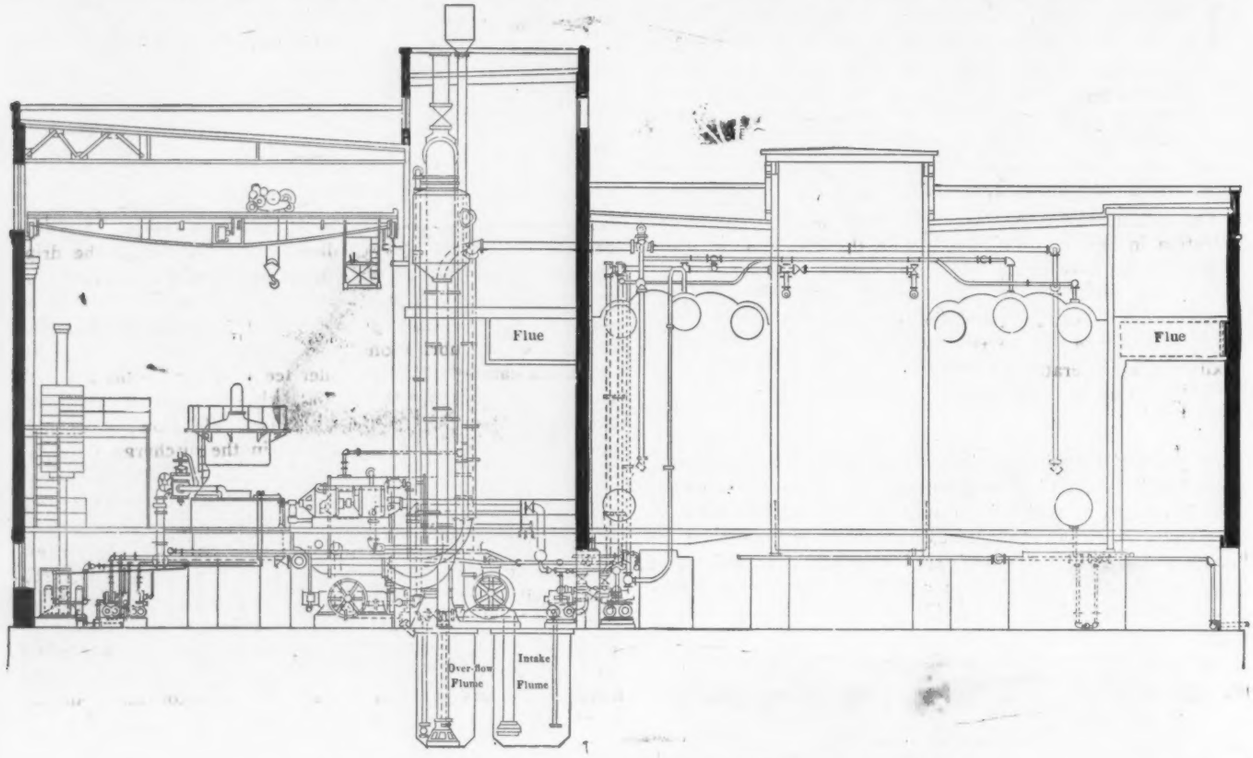


FIG. 4.—ELEVATION OF EAST BRIDGEWATER GENERATING STATION.

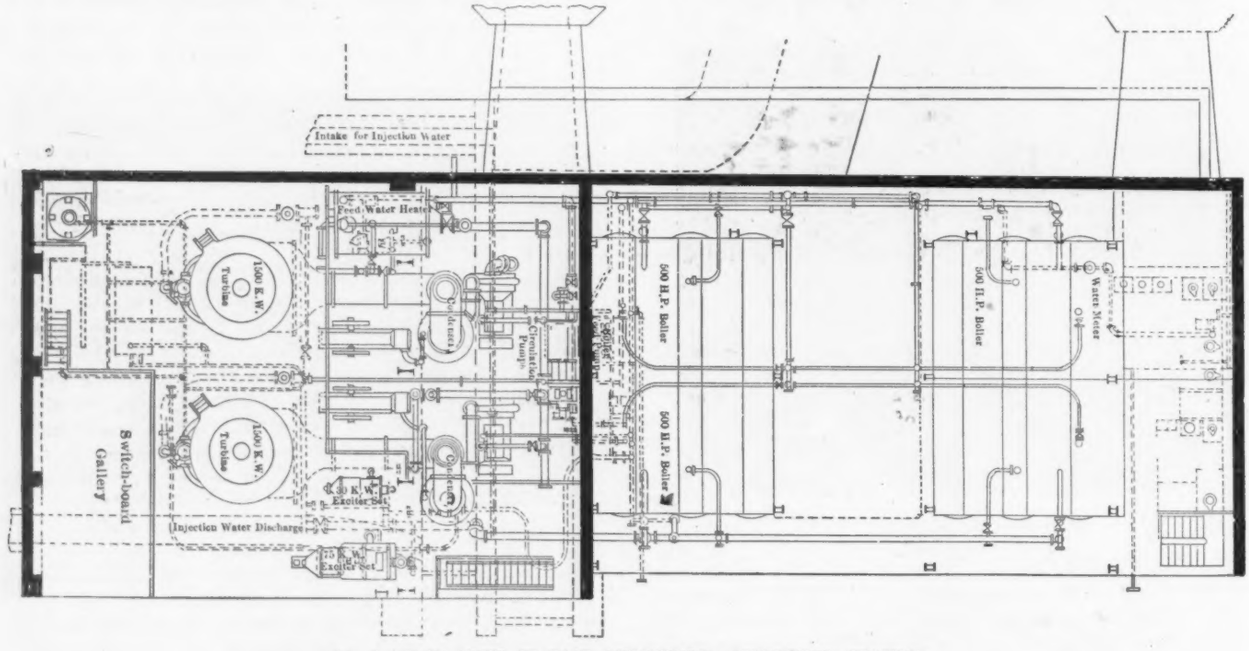


FIG. 5.—PLAN VIEW OF EAST BRIDGEWATER GENERATING STATION.

The boiler room is about 52 ft. long by 41 ft. wide. It contains at present three 525-hp Stirling water-tube boilers built for 200-lb. steam pressure and equipped with U-tube superheaters. Two of the boilers are provided with grates 10 ft. deep and the third has an 8-ft. grate, the common width being 5 ft. 4 in. The company desires to try the two different lengths to see which gives the more satisfactory service results. The ashes are dropped from the pits into hoppers in the basement. These hoppers are provided with slides operated by geared hand-wheels and deliver the ashes into a car which is run beneath the hopper spouts on a narrow gage track, and thence out of the building, where the ashes are used for filling purposes.

The firing aisle is about 15 ft. wide. At present the boiler on the north side of the room delivers its products of combustion into a flue which leads downward and out of the building to the stack by a special concrete duct carried on the outside of

the building parallel to the boiler-room wall. When enough boilers are installed to require another stack, the concrete smoke flue can be taken down and another run directly from the boilers on the north side of the station to the new stack. Each boiler is provided with a 6-in. superheated steam and a 3-in. saturated steam delivery outlet. The turbine installation is supplied with superheated steam only, but the auxiliaries are piped for both saturated and superheated service.

Two Curtis turbo-alternators are at present installed, each rated at 1500 kw. The machines are of the four-stage type and deliver 60-cycle, three-phase currents at 13,200 volts. The step bearings are operated at about 400-lb. pressure per square inch and an accumulator is installed to provide for about 10 minutes' operation in case anything happens to the step-bearing pumps located in the basement. Two turbine-driven exciters are installed; one rated at 30 kw and the other rated at 75 kw. Both machines are wound for 125 volts, and the speed of the smaller is 3600 r.p.m. and that of the larger unit 2400 r.p.m. All the auxiliaries are operated by steam.

Each turbine receives steam from a 10-in. line connecting

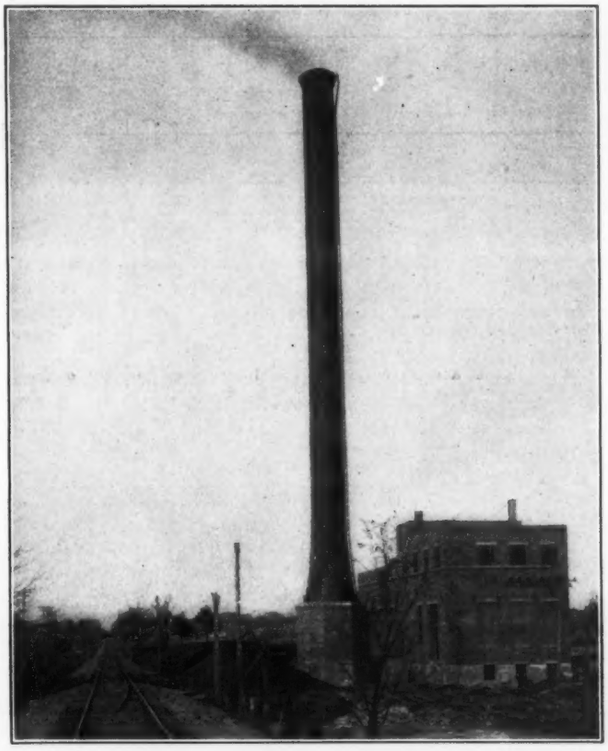


FIG. 6.—GENERAL VIEW OF NEW POWER PLANT.

with a main leading to the boiler room, one main being run through from each side of the boiler room to the turbine room beneath the floor. The two mains are cross-connected in the basement to increase the reliability of the steam supply.

Each turbine exhausts into a Heisler barometric jet condenser through a 36-in. connection. The injection water is drawn from the river through a concrete conduit and delivered into a horizontal flume which is carried transversely beneath the turbine room. The intake at the river bank is protected by a 2-in. mesh screen and by ¾-in. and ½-in. screens at the station end. The various pumps are grouped about this flume in such a manner that the pipe runs are of minimum length. The injection pumps are of the centrifugal pattern, direct driven by automatic vertical-compound Westinghouse engines. The water for each condenser is supplied to the head through a 14-in. pipe attached to the delivery outlet of the corresponding centrifugal pump. Steam is supplied to the pump engines through a 3-in. line in each case, the lines being carried through the basement to a 5-in. auxiliary main. Close by the circulating pumps are located two Heisler dry-vacuum pumps. The boiler-feed pumps are of the Blake duplex type, and each pump is equipped with a Richardson sight-feed lubricator and an automatic steam supply valve. A 4-in. main from the town service is utilized in emergencies. The feed water is pumped hot to the boilers at a temperature of about 210 deg., the boilers being supplied through 2½-in. piping. All high-pressure drips are returned to the boilers by the Holly system. The exhaust from the various auxiliaries is taken into a 12-in. main in the turbine room basement and then carried into a Cochrane open-type feed-water heater located in the turbine room on the machinery floor level. Water is lifted from the well to the heater by a centrifugal pump direct-connected to a 4-hp, 220-volt induction motor. A Blake general service pump is installed in the basement. The drips from the auxiliaries are brought into a concrete well outside the turbine room and the water and oil are allowed to separate by gravity. The oil is later pumped out by hand and is used again in the auxiliary lubrication. The feed-water heater is by-passed and water can be drawn for boiler feed either from the hot well, the cold well or the town main, with the heater in or out of service as may be desired in each case. Thermometers are located in the injection water piping, in the discharge from the condensers, turbine exhaust pipes, superheat main of the boiler room, main flue, heater supply line, feed pump discharge line and on the lines for the turbines a recording thermometer is installed to check the boiler performance and show the general condition of the superheater flues. Ellison draft gages are used on the boiler, and a carbon dioxide recorder has been ordered. The feed water is measured by a Venturi water meter, with indicating and recording dials. The latter are integrated daily by a planimeter. Town water is measured by a regular service meter. The turbine room has a Whiting 20-ton motor-driven crane, with operating elevated platform and a span of about 37 ft.

The switchboard contains at present 12 panels of black enameled slate. There is one panel for a Tirrill regulator, with synchronizer bracket attachment, two exciter panels, two turbine panels, two station auxiliary panels, two 13,200-volt line panels, one 2200-volt feeder panel and two panels for turbine gages.

The turbine steam panels each contain pressure gages for the steam supply, the step bearing and the first turbine stage, with a vacuum gage in addition. To enable accurate readings of the vacuum to be made a mercury column gage has been installed upon the switchboard. The average vacuum obtained is about 28.6 in.

The station supplies East Bridgewater with electricity at 2200 volts, and in October will supply Abington, Rockland and Hanover by a 13,200-volt line, which is at present being built. The most distant point from the plant that will be supplied under this arrangement is 17 miles from the station.

The plant is operated on eight-hour shifts, 24 hours per day. At the present time the maximum load comes on Wednesday and Saturday evenings, and it averages about 1500 kw. The load averages about 500 kw between 7 a. m. and 5 p. m. in the summer season. It is expected that in the coming winter the load will be considerably larger. The present operating force of the plant consists of three engineers, three oilers, one electrician, four firemen and two coal passers. The coal consumption averages 20 tons per day for five days of the week. In the old station the average coal consumption per kw-hour averaged 5.4 lb., while in the new plant it averages at present 3.5 lb.

The two transmission lines which connect the new plant with the substation in Brockton are of No. 2 copper. The lines run overhead except for one-third of a mile in Brockton, where they run underground. The cables are brought into the basement of the new substation and carried to 13,200-volt oil switches located in compartments beneath the operating room. The equipment of the substation consists of three 375-kw, 13,200- to 2200-volt, oil-cooled transformers for general service, nine 75-kw transformers for use with rotary converters, three 200-kw, 250-volt rotaries for three-wire service, and a 44,000-volt testing transformer.

The 13,200-volt cables are tapped in each phase with leads

running to static dischargers fitted with disconnecting switches. The main cables run to series transformers, and thence to oil circuit-breakers with trip coils. From the circuit-breakers the lines run to disconnecting knife switches and thence to two sets of busbars, which are provided with bus-junction knife switches at their middle points. From the busbars the circuit is carried through disconnecting switches, circuit-breakers and series transformers to the step-down transformers supplying the three-wire rotary service and the commercial and street lighting load of the plant. Motor-operated induction regulators are installed in the feeder circuits, and the oil-switch trips are operated by a small storage battery, which is charged through a 0.6-hp motor-generator set. A 2-hp air compressor is located in the basement for cleaning purposes. Test cables with an insulation for 60,000 volts are provided for cable tests in the substation. From this substation the towns of Whitman and Stoughton are supplied with electric energy, in addition to the service in Brockton. For transmission to Stoughton the potential is raised to 6600 volts at Montello, a suburb of Brockton, and current is delivered at this voltage in the Stoughton substation, which is about six miles from Brockton. The chief engineer of the Brockton company is Mr. H. A. Davidson. Mr. A. F. Nelson is the local manager, and Stone & Webster, Boston, are the general managers of the company.

Steel Tower Transmission Line.

The Milwaukee Electric Railway & Light Company is building a steel-tower transmission line which includes in its design many features of interest. It will serve as a main artery of energy distribution for the Milwaukee company's chain of interurban and lighting properties extending westward from the city of Milwaukee. A considerable increase in the load in this territory is anticipated, and the new line is being built with a view to permanency and with ample size for future development. The route in general follows the Watertown extension

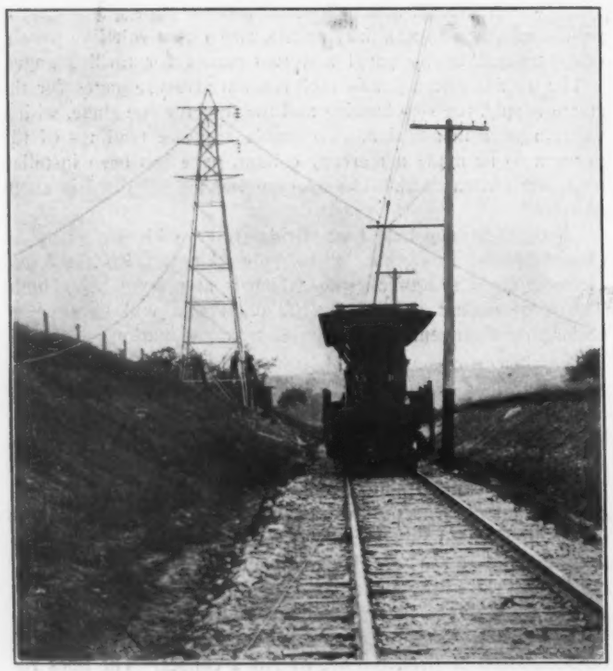


FIG. 1.—ELECTRIC CAR USED FOR RAISING A TOWER.

of the Milwaukee Electric Railway & Light Company's interurban system. The eastern terminus of the steel-tower transmission line is at a switching station at Waukesha Beach, into which energy is fed from the Milwaukee plants over duplicate transmission lines made up of underground cables, and standard wooden-pole transmission lines carrying energy at 33,000 volts. From Waukesha west the line of steel towers will closely parallel the interurban track 53 miles to Watertown. Detours are made around some of the towns so that the line may be clear from obstructions.

Mr. O. M. Rau, electrical engineer of the Milwaukee Electric Railway & Light Company, and Mr. D. R. Scholes, chief engineer of the Aermotor Company, Chicago, which built the towers, executed the design of this transmission line and planned the

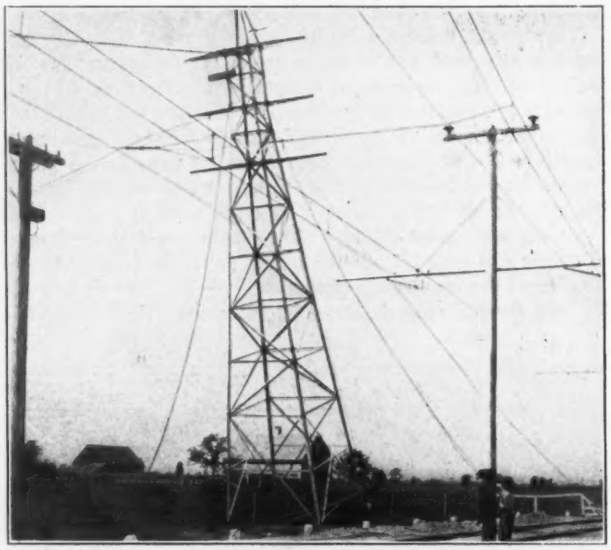


FIG. 2.—TOWER BEING DRAWN INTO POSITION.

novel erection methods employed. Before deciding upon the use of steel towers a careful comparison was made between them and a wooden pole line, and the steel towers were found preferable. Special care was used in the design of the towers so that all necessary expense was eliminated. The resulting transmission line cost very little more, and had far greater

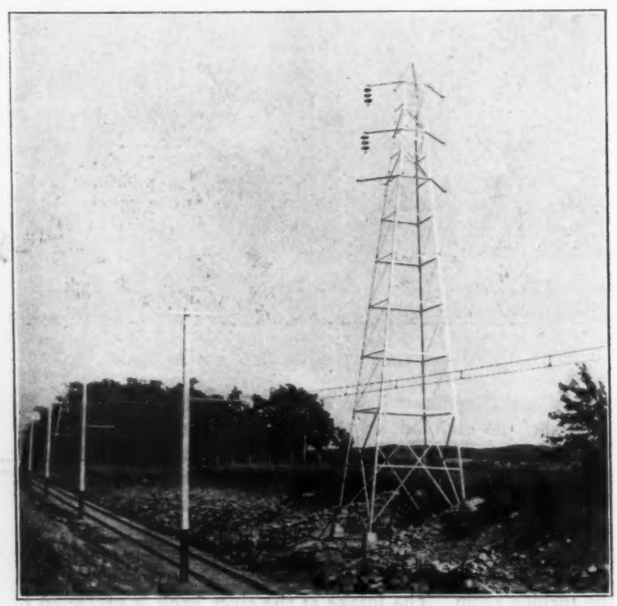


FIG. 3.—TOWER IN PLACE.

permanency than could have been obtained by the use of wooden poles. The accompanying illustrations show the general appearance of the towers.

The standard towers are of such a height that the lowest conductor is 40 ft. above the ground at the tower when this conductor is supported by the suspended type of insulator. Two three-phase lines eventually will be carried on this line of tow-

ers. A few special towers carrying the lowest wire from 50 ft. to 60 ft. high were furnished for locations where it was desirable to perfect the grade of the line. The base dimensions of each tower are 12 ft. x 12 ft. at the ground line. The towers are designed to withstand actual test loads of 1500 lb. applied to any insulator support and 8000 lb. applied to the tower structure near the top in a horizontal direction, either at right angles to the line or parallel therewith. The anchorage consists of an angle bar 5 ft. long provided with footplates at its lower end embedded in concrete.

The towers supporting the transmission line are made of steel throughout, galvanized by the hot process after all shop work, such as punching, shearing, machining, etc., had been completed. They were shipped completely "knocked down" and were assembled in the field by means of bolts. Extra heavy towers were furnished for corners in the line and these towers were subjected to test loads of 3000 lb. applied to any insulator support, and 20,000 lb. was applied to the tower structure near the top in a horizontal direction, either parallel to the line or at right angles therewith. The towers withstood these tests without permanent distortion of any part or any sign of weakening.

The towers located at corners are provided with cross-arms of extra length, so that the distance between conductors will not be decreased at the corners.

Where the transmission line follows the railway tracks the average length of span is 550 ft., the spans ranging from 400 ft. to 600 ft. in length. The concrete anchorages for the four legs of the towers vary between 2 ft and 3 ft on a side, according to the necessity of the locations. The transmission wires for each three-phase circuit are carried one above the other in a vertical plane. No attention was paid to arranging them at the corners of a triangle and there will be no transposition in the circuits.

Particular attention was paid to obtaining an extremely high insulation for the lines, as Mr. Rau believed that this is an important factor in providing against troubles from lightning. At the top of each tower provision is made for carrying a grounded cable. This cable, however, will not be installed until experience has shown its necessity. Electrolytic arresters will be connected with the line at the stations, and the operating forces will make it a special point to watch the disturbances occasioned by lightning. Whether or not additional lightning protection will be supplied will depend upon the results of these observations.

The conductors of the three-phase circuits comprise aluminum cable equivalent in conductivity to No. 0 copper. The sections of this cable are connected by McIntire splices. The lines will be operated at 40,000 volts pressure, the wires being carried by Thomas suspended-type insulators, each made up of three 20,000-volt sections. The aluminum cables are supported from the insulators in clips of the saddle type. These clips are fitted with arcing rods so that if an arc occurs near a tower the discharge will take place between the 4-in. iron arcing rod and the tower, thus protecting the aluminum conductor. On an average span of 550 ft., the conductor cables were strung with a sag of 18 ft. at + 80 deg. Fahr. Under the extreme conditions (a temperature of — 30 deg. Fahr. with wind at 50 miles per hour) the factor of safety of the transmission line is 5.5.

As already stated, the towers were assembled on the ground and erected as a unit. With the concrete anchorages in place and a tower assembled, two legs of the towers were connected to the angle-iron anchorages by means of special erecting hinges. These hinges were temporarily fastened with bolts and after erection were removed and the legs of the tower bolted in place. When a tower was ready for raising, the tackle was so arranged that the pulling rope could be fastened to the coupler of the electric car. Thus as the car moved along the track the tower was quickly raised into a vertical position. It is stated that after the preparations were completed a tower could be raised into position in the space of three minutes' time. As many as 10 towers were erected per day by the method outlined.

Large Oil-Engine Electrical Plant.

The State of Florida has no metals and its chief mineral industry is the mining of phosphate rock for fertilizers, the deposit being one of the most extensive in the world. The phosphate rock is found in various forms—hard and soft rock, land and river pebble, and vertebrate remains containing large quantities of phosphate of lime. In Polk County, hydraulic mining is used in many places to obtain the phosphate deposits which are washed down after the top soil has been removed, pumped to washeries, screened, roasted and shipped in its rough form to Germany where it is put into marketable shape. At two of the mines in Polk County, the Prairie Pebble Phosphate Company's and the Pierce Phosphate Company's, modern, oil-engine-driven, electric generating stations have been erected to supply electrical energy for lamps and motors throughout the mines.

The station of the Prairie Pebble Phosphate Company is located at Mulberry, Fla. The installation comprises seven generating units, each consisting of two 225-hp Diesel oil engines direct-connected to one 300-kw Allis-Chalmers, 2300-volt, 60-cycle, three-phase generator having a normal speed of 164 r.p.m. Each unit is provided with a 16½-kw belted exciter. A view of the generator room is given in Fig. 2. The Prairie Pebble Phosphate Company already had a combination generating station in which apparatus aggregating 600 kw is installed. This power, combined with that received from several small steam

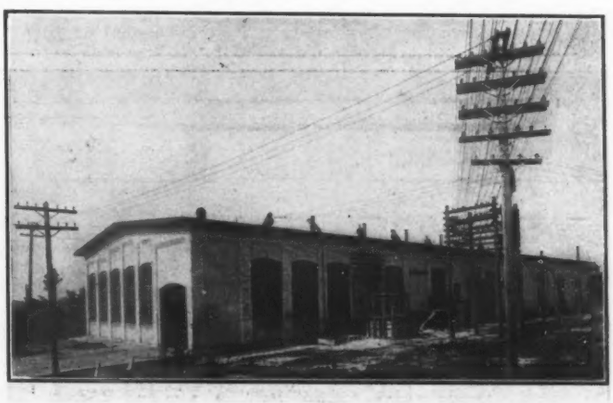


FIG. 1.—EXTERIOR OF PRAIRIE PEBBLE STATION.

engines about the mines, was inadequate for the growing demands of the company. With the decision to erect a new generating station came the question of prime mover. Fuel of whatever kind must be brought to Florida, and considering the nearness of the Texas oil fields and the economy of oil engines, the latter was the type of prime mover chosen.

An exterior view of the power house is shown in Fig. 1. This is built of white brick and covers an area 183 ft. x 58 ft., the building being 26 ft. high. A trolley hoist is provided in the station so that repairs such as the removal of pistons or cylinders, etc., can be effected with ease. The 14 engines at present installed have cylinders 16 in. x 24 in. stroke. The compressed air required by the engines is supplied from five three-stage compressor units each of which is driven by a 75-hp motor through steel pinions. The pressure of the air ranges from 65 to 75 atmospheres, and three compressors furnish air enough for the plant when operated under full-load conditions, so that two may be held in reserve. In addition six air storage tanks are connected to each unit, the air from four of the tanks being used for starting and the air from the other two is used for oil injection. A reserve battery of 20 bottles charged under a pressure of 75 atmospheres at all times is also available for instant use. The engines and compressors are water-cooled, jackets being provided for that purpose and the water is supplied through two volute pumps each of which is driven by a 7½-hp motor. The water is taken from a pool near by.

Each pair of oil engines is supplied with fuel oil from a bat-

tery of three tanks each holding 30 gal. The tanks are in turn filled from a main storage tank situated close to the station and holding 84,000 gal. The oil is brought to the tank in cars over the Atlantic Coast Line and is pumped from the tank to the small tanks in the station by two oil pumps, each driven by a ½-hp single-phase motor. One pump is held as reserve,

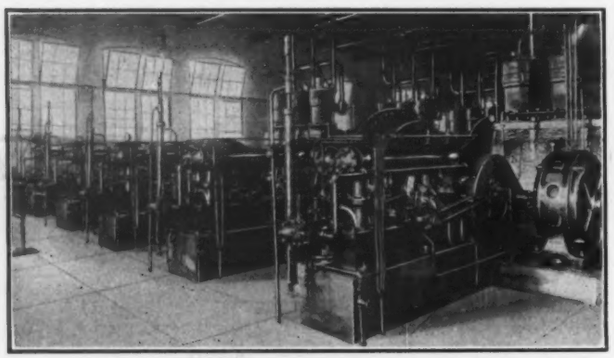


FIG. 3.—COMPRESSORS IN PRAIRIE PEBBLE STATION.

the other being large enough to meet all requirements. All the oil pipes are placed under the floor of the station.

In order to ascertain the performance of the oil engines on the basis of the guarantees and stipulations contained in the contract, tests were made by Mr. R. E. Ludwig, of Mulberry, Fla., for the purchasers. These tests were concluded on July 2. with positive speed counters rigidly connected with the cam shafts of the engines. The oil consumption was ascertained by weighing the oil used. The contract contained the following stipulations: The consumption of fuel, either crude or fuel oil, is not to exceed 8 gal. when running at or near full load, nor 9.5 gal. when running at or near half load per each 100 brake hp-hours. Each unit is to develop 450 brake hp, which is the power required to deliver 300 kw at the switchboard besides furnishing the required amount of power for the air compressor. The regulation of the engines is to be sufficiently close to permit satisfactory operation of alternators in parallel. The speed limit is to be from 160 to 170 r.p.m. or a total speed range of 10 revolutions between no load and full load.

The fuel used in the engines in regular operation and throughout the tests was a desulphurized Texas fuel oil. The certificate of analysis showed the following characteristics:

Specific gravity at 60 deg. Fahr.	0.8689
Equivalent to degrees Beaumé	32
Weight per gal. at 60 deg. Fahr.	7.238 lb.
Flashing point	150 deg. Fahr.
B.t.u.	19,521
Water	None
Sulphur	0.17 per cent
Acidity	None

The oil consumption tests were made on four units and gave the following results:

Oil used per hour.		Oil used per 100 kw-hours.	
Full load 315 kw.	Half load 160 kw.	Full load 315 kw.	Half load 160 kw.
196.6 lb.	100.25 lb.	8.62 gal.	8.66 gal.
187.38 "	102.8 "	8.22 "	8.88 "
195.5 "	102.0 "	8.57 "	8.81 "
187.0 "	102.5 "	8.20 "	8.85 "

The combined average of the full load and half load consumption is 8.60 gal., which checks quite closely with the total

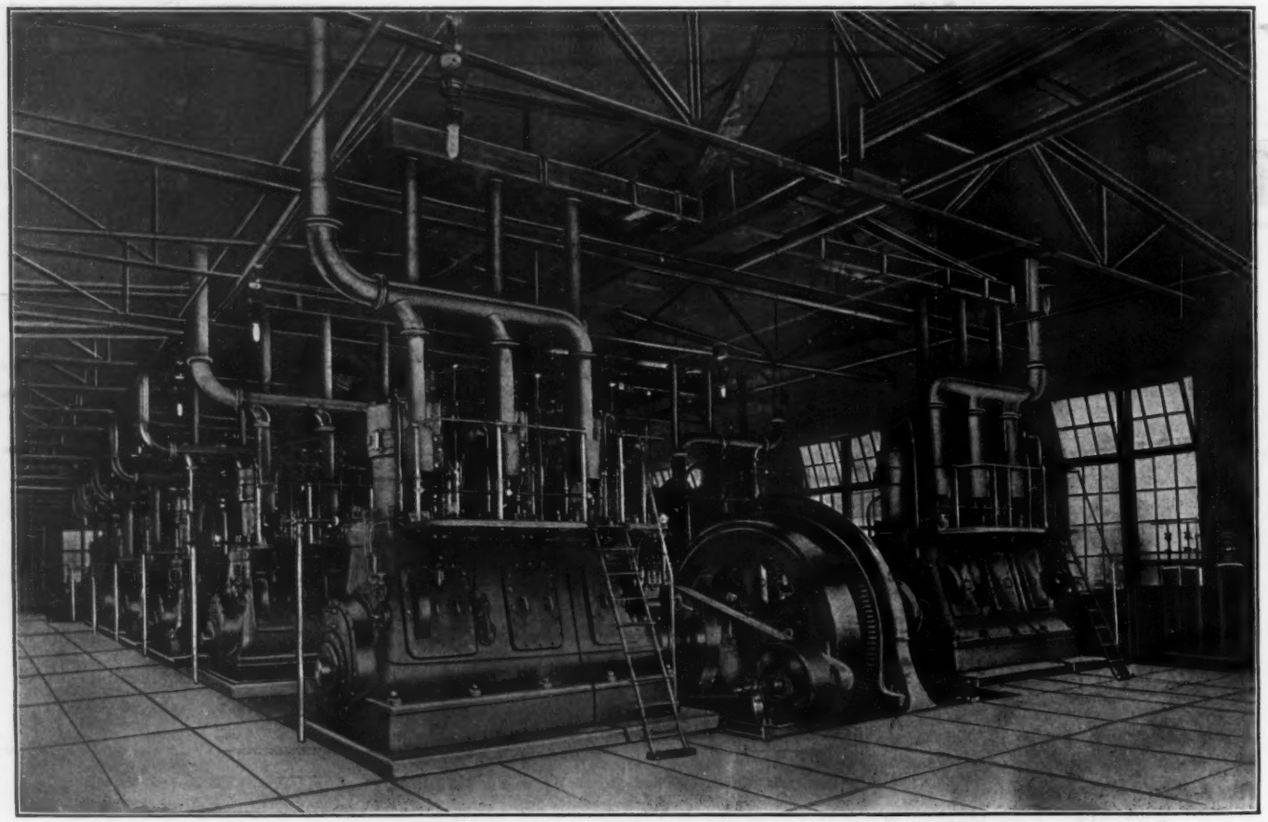


FIG. 2.—GENERAL VIEW OF THE GENERATING STATION OF THE PRAIRIE PEBBLE PHOSPHATE COMPANY.

Each unit was tested separately, being disconnected from the balance of the plant. The load was obtained by using a water rheostat and care was taken to keep the load on all three phases balanced as closely as possible. The compressors were not operated from the units under test, but were driven from the general busbars. The electrical load was measured by means of a polyphase watt-hour meter previously calibrated and checked by instruments of precision. The speeds were taken average consumption of the whole plant in regular operation, which the station records show to be about 8.5 gal., as recorded by oil meter. The contract guarantees are based on brake hp-hours and cover the oil consumed by the compressor, but not that required to drive the exciter. The average full-load excitation during tests was 8.7 kw, requiring about 13.7 hp per unit. One compressor requires the equivalent of 60 hp or 30 hp per unit. The allowance for the compressors was therefore

deducted from the switchboard reading, while that taken by the exciter was added to the reading. The allowance was 16.3 hp per unit, which corresponds to about 12.2 kw at the switchboard. The net load delivered by the unit under test was thus easily obtained. Using these figures and the generator efficiencies, the oil consumption, computed on the contract basis, is shown to be as follows:

Load.	Net brake hp.	Gal. of oil per 100 brake hp. Test.	Guarantee.
315 kw	435.4	6.08	8.00
160 "	219.9	6.40	9.5

These results show that the oil consumption of the engines

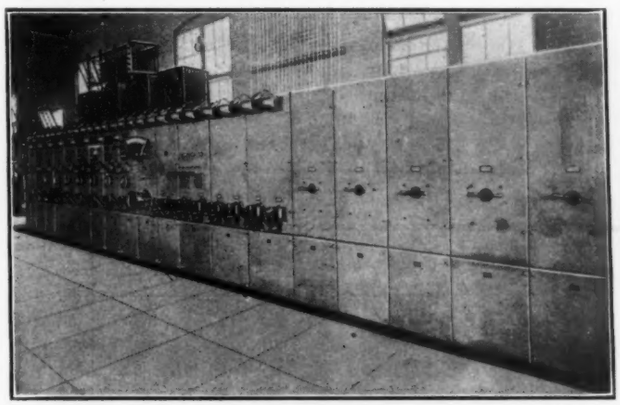


FIG. 4.—SWITCHBOARD IN PRAIRIE PEBBLE STATION.

was less than the guarantees given in the contract. The load limit at which the units slowed down varied from 335 kw in two instances to 345 kw in two other units.

The plant is in operation from 6 p. m. Sunday to 6 a. m. the following Sunday, or practically 132 hours per week. The generators operate in parallel as well as the exciter units, and the output, with the exception of about a 10-kw load for lighting, is used entirely for motors. It will, of course, be understood that the mines cover considerable territory so that the voltage is stepped-up for transmission at 11,000 volts to two mines from 10 to 14 miles away, where the voltage is stepped-down to 2300 and fed at that tension to motors driving pumps. The transmission lines are of bare copper wire strung on native poles. The transformer house, which is near the station, is a

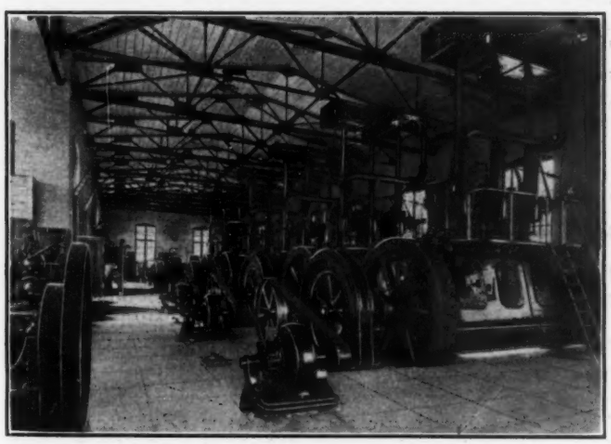


FIG. 5.—OIL ENGINE-DRIVEN GENERATORS IN PIERCE STATION.

fireproof structure in which are placed three 300-kw oil and water-cooled transformers. The switchboard is shown in Fig. 4. This is made up of eight machine panels, one totalizing panel, four feeder panels, five motor panels and one alternating-current and one direct-current rotary converter panel for a 100-kw set.

In the process of mining the phosphate, water from 1¼-in. and 1½-in. nozzles at a pressure of 175 lb. is directed against the bank. The phosphate is washed to a stump hole connected to the suction side of a 10-in. centrifugal pump driven by a 125-hp motor. The phosphate is thus taken to the washery, where another pumping outfit of like size is installed. From the discharge pipe of this pump the phosphate is delivered to the top of a washery 40 to 50 ft. high, where the rock is screened and passed through log washers driven by a 30-hp induction motor whence it is stored in bins or delivered into cars which take the phosphate to the roasters. Water for mining is taken from artesian wells and the pumps used for throwing the stream are at present steam-driven.

For supplying energy to the telpher and direct-current trolley system, a 100-kw rotary is installed in the main station and another in the upper station. The latter also contains three 200-kw alternators driven by Fleming engines. The telpher system is 580 ft. long and the bucket has a capacity of two tons of phosphate every two minutes. The phosphate is delivered either to the roaster or a pit, whence it is stored in a dry bin holding 24,000 tons. The trolley line, of standard construction, runs from the mines and delivers the phosphate rock to the telpher. The six roasters used in the Prairie plant are driven by as many motors. The grounds are lighted by arc and incandescent lamps. The motors driving pumps in the mines, which go down as low as 30 ft., are placed in portable houses containing also the resistances, controller and starting panel. The pump is

FIG. 6.—EXTERIOR OF PIERCE GENERATING STATION.

outside of the house, and the latter being on wheels, it can be moved as occasion requires.

The station of the Pierce Phosphate Company is located at Pierce, Fla., five miles below Prairie. The power house is shown in Fig. 6 and an interior view is given in Fig. 5. The building covers an area of 136 ft. x 36 ft. and houses six Diesel oil engines, two of which are direct-connected to 150-kw, 550-volt direct-current generators of Allis-Chalmers make, one is direct-connected to a similar generator of Ft. Wayne make, and three are connected to 160-kw, 2300-volt, three-phase, 60-cycle Ft. Wayne alternators. The six compressors are driven by as many 25-hp, 550-volt motors and there are three plunger pumps and two oil pumps also driven by direct-current motors. The switchboard in this station is made up of six machine panels, three alternating-current feeder panels and two direct-current feeder panels.

The direct current is used at Pierce for driving motors attached to pumps, roasters, elevators and conveyors; the alternating current is used for lighting and for a 125-hp pit motor. The balance is transmitted 2½ miles to mines where it is used for motors, lamps, etc. The phosphate is mined at Pierce by means of a stream of water just as in Mulberry, only that in the former case the pumps are motor-driven. The contractor for both installations was the H. B. Rust Company, of Providence, R. I.

Insulating and Sheathing High-Tension Underground Cables.

By Henry Floy.

In view of the present use and reliability of high-tension underground cables, a description of the methods of insulating and sheathing such conductors will be of interest.

The early attempts in America at operating conductors underground were made by the Edison Companies. Even for the low potentials they employed, the type of insulation available at that time was found insufficient and unsatisfactory for subsurface work and resulted in investigation and experimentation which developed the merits of rubber and gutta percha. The former was adopted almost exclusively where the use of increasingly higher potentials was attempted. However, on account of its high cost, substitutes for rubber were quickly sought and paper carefully wound, thoroughly dried out and impregnated with mineral or linseed oil, a compound of rosin, wax or bitumen, was soon found to be satisfactory provided dampness and moisture could be kept away. This has been accomplished by enclosing the insulation in a lead sheath, which, as long as it remains intact, allows paper insulated cables to give very satisfactory service for even the highest voltages yet commercially employed under ground. More recently, shellacked cambric has been used, which, although more costly than paper, is appreciably less expensive than rubber, and unlike the former, does not quickly depreciate in the presence of water.

Recently cables have been made with rubber and paper, or rubber and cambric insulation combined. By using rubber next to the conductor and paper or cambric outside the rubber, the more expensive and better insulation is distributed where its greater strength is most advantageously used. Attempts have been made to enclose paper insulation with a light jacket of rubber as a protection against moisture; but owing to the difficulty of vulcanizing the rubber without injuring the paper, such results have met with but little success.

Where two or three-phase currents are employed for high-tension work, the underground conductors required for such a circuit are usually separately insulated, laid up with jute and then the whole enclosed in a "jacket" of insulating material, which further insulates, to ground, and helps protect, mechanically. Concentric cables consisting of a rod, insulated, and inserted in one or two metal tubes, as the second or third conductor, were early employed, particularly abroad, but have not demonstrated their claims to superiority and their use is being restrained, in Germany, for example, being prohibited for voltages over 3000. On account of the increased thickness of insulation required with higher potentials, say from 50,000 volts upward, single conductor cables will probably be necessary for such work, at least when they are to be much handled or drawn in ducts.

Rubber insulation, that is, of the highest grade and at the same time absolutely uniform in quality, is very difficult to obtain, due partly to its method of application. This lack of homogeneity, the inability of the rubber to readily withstand heat and its higher cost have tended to popularize the use of paper insulation despite the liability of the latter to damage from moisture or cracking upon being bent, so that by far the larger proportion of high-tension cables in use at present are paper insulated.

The dielectric strength of rubber is much higher than that of treated paper, being as high as 20,000 volts per millimeter of thickness in thin sheets, whereas the same thickness of paper will not withstand more than about half this potential, so that unless some other materials are found, it is likely that rubber must be used, at least in part, on cables designed for the highest potentials, in order that the completed cable may not become so great in diameter as to be cumbersome and impracticable to handle. It was early appreciated that doubling or tripling the thickness of a given insulation did not increase its ability to stand up under applied electrical stresses, in anything like the same ratio. It was found, with an insulation of homogeneous material, that the fall of potential through the insulation, from the conductor to the lead sheath, was not uniform but decreased very much more rapidly nearest the conductor, being for a certain insulation, for example, 5000 volts per millimeter of insulation next the conductor and only 1000 volts for the same thickness next the sheath. Without more fully considering what may be the fall of potential along the radii, from the surface of the conductor to the sheath, or the complex formula by which these values may be calculated, for various dielectrics, it may be said that both theory and experiment prove the fact; and, furthermore, that the rate of fall of potential varies with different materials, depending upon their various specific inductive capacities. Knowledge of these conditions led an Englishman, Mr. M. O'Gorman, and an Italian, Mr. E. Jona, about the same time, to suggest equalizing the fall of potential so as to secure a uniform or practically uniform "potential gradient" throughout the insulation either by impregnating the insulating material to different extents depending on its distance from the conductor, or by applying successive layers of insulation each made up to have different inductive capacities with the layers arranged so that those of material with the highest capacity should be nearest the conductor. This arrangement of insulating material causes the outer layers to support approximately the same strains per unit of thickness as the inside layer; and hence, the total stress due to the potential of the conductor is supported by a wall having a total thickness of insulation very much less than if homogeneous. Theoretically, the insulating material should vary gradually instead of by layers; but this, of course, is impracticable, so that the fall of potential from conductor to sheath proceeds by a series of small steps instead of in a smooth curve.

Experiment with high potentials seems to have demonstrated that the distribution of stress in solid dielectrics, such as paper or rubber, is very similar to that which we know occurs in air. About conductors of small diameter air apparently breaks down, resulting in a conducting medium made up of the solid conductor and air, which is considerably larger in diameter than the solid material. It is probable that similar action takes place with the insulation about conductors of small diameter, so that the dielectric itself, for a small distance from the conductor, breaks down and becomes also a conducting medium. In any case, it is clear that insulation of a given character about a conductor of large diameter will sustain a considerably higher potential before puncture, than the same insulation about a small conductor. As a result of experiments made by him, Mr. Jona concludes that by sheathing a copper conductor in lead, thus both increasing its diameter and affording an absolutely smooth and cylindrical exterior, there may be produced "a diminution in the potential gradient in the very first stratum of dielectric of something like 20 to 30 per cent or even more," and he has so sheathed with lead high-tension cables made under his direction. The theory of applying layers of insulating material having different capacities has been carried out in practice and the value of "graded" cables for high potentials successfully demonstrated. For example, there was shown at the 1906 Milan Exhibition such cable, having a total thickness of insulation of only 14.5 mm, though designed for a normal working pressure of 100,000 volts, and at present there are installed across the Lake of Garda, Italy, single-conductor "graded" cables operating at 13,000 volts. These cables are insulated by several layers of vulcanized India rubbber to a total thickness of 5.5 mm. Outside the rubber is a coating of 1.2 mm of gutta percha to further insure imperviousness. This is covered with "tanned jute" and armored with No. 18 steel wire 3 mm in diameter. As three of these cables are required for three-phase operation an interesting device was resorted to in order to avoid undue self induction; each of the steel wires used in armoring was wrapt with tarred hemp before being wound around the insulated conductor. The result of this experiment seems to be satisfactory, as the drop of pressure due to self-induction is reported to have been reduced to the same amount as the drop due to the ohmic resistance.

Variation in the capacity of rubber used for "graded" cable

is obtained by "loading" it with other substances such as talc, zinc, etc., while the capacity of paper may be similarly varied by changing the quality of the paper or the process of impregnating. Rubber cable has appreciably more capacity and a larger charging current than paper or cambric-insulated cable.

The specific capacity of any homogeneous insulating material or the "effective" specific capacity of "graded" insulation on a single conductor cable is determined by the formula:

$$K = M \log 10 \frac{R}{r} \div 0.000439.$$

When M = capacity per mile in microfarads measured on lead-covered or water-immersed cable; R = radius of insulation, and r = radius of conductor.

The process used at present for impregnating cables has the effect of sometimes giving the greatest dielectric strength and capacity where they are not wanted, namely, in the outer layers of the insulating material. This is due to the fact that the liquid used for impregnating more easily reaches and solidly fills the outer portion of the dielectric. As often manufactured, rubber cables are subject to the same fault; because pure rubber, which is of the lowest specific capacity, is placed next the conductor, the tougher degraded or vulcanized rubber of greater capacity being used for the outer layers. While the unequal distribution of dielectric strength is of little importance in itself, there is greater danger of a break-down than if the insulation were homogeneous throughout, due to the increased capacity created in the outer layers.

Although it may seem that the capacity of a rubber insulated cable might be of value in equalizing the lag due to induction in a circuit, the advantage will only follow where the full value of the capacity current can be constantly utilized, as it remains uniform at all loads; whereas, the inductance varies with the load. Any benefit to be derived from the charging current then will be simply in increasing the carrying capacity of the circuit.

In insulating copper conductors with rubber, it is considered necessary to tin them in order to prevent any free sulphur left in the rubber from attacking the copper. To this same end a thin layer, 1/64 to 1/32 of an inch in thickness, of soft, pure rubber is used by some manufacturers, next the conductor, as an additional preventive in keeping the sulphur away from the copper. With any except conductors of very small diameter, this use of pure rubber is a needless expenditure of care and money; because, if the conductor is carefully tinned and the rubber properly vulcanized, the chance for sulphur's attacking the copper is very small on two accounts: First, even if there are imperfections in the tin and the sulphur gets through the imperfections, the amount of copper degraded will be so small relatively that the conductivity of the conductor—except with possibly the very smallest conductors—will not be reduced, as a practical matter; and second, the amount of free sulphur in properly vulcanized rubber insulation is so small that with conductors of large cross-section, even not tinned at all, the extent of damage to same would probably be immaterial. With paper and cambric insulation, where no sulphur is present, tinning is not necessary and is not resorted to.

Some tin is usually alloyed with the lead used for the outside sheath. Pure lead is so soft and would so soon become friable and weakened by combination with the carbonates or other deleterious substances that the commercial lead, which usually contains some antimony or other impurities, is fortunately a much better material. Lead alloyed with tin makes a harder sheath and one less liable to injury from contact with the sharp projections or edges encountered in drawing in conduits. The amount of tin specified for cable sheathing is usually not less than 1 per cent or more than 5 per cent. As a practical matter, 1 per cent is a rather small quantity and 2 per cent as a minimum with 3 per cent as a maximum make desirable alloys; 5 per cent is apt to make the sheath too stiff and brittle. In some instances, purchasers require that the lead sheath be dipped in a tin bath, with the evident purpose of making a hard exterior, which, while affording a finished surface, is probably too thin to prove much of a mechanical protection, but which doubtless fully protects lead against carbonic acid gas or other deleterious products which may attack the lead, and is therefore desirable under certain conditions of installation.

The thickness of the lead sheath should be proportioned for the weight, type of insulation, and character of service of the cable. For small rubber insulated cables, 1-16 in. lead is a sufficiently heavy sheath with something thicker in case paper insulation is used. With large paper insulated cables, it may be necessary to use a sheath as thick as 3-16 in., but anything heavier than this is apt to make a very stiff cable.

In the early days of cable manufacture, high insulation resistance as measured in megohms was considered an indication of good cable construction. As far back as 1899, when drawing specifications for the 25,000-volt St. Paul cables, the writer waived all resistance insulation tests, depending rather upon perforation tests to determine the excellence of the insulation, realizing that insulation resistance is not a measure of disruptive strength, they being independent of one another. Modern practice concurs in these views and megohm requirements in high-tension cable specifications have been much reduced or omitted as insistance on high ohmic requirements is likely to result in the production of a non-flexible and brittle insulation. Nevertheless, as is generally recognized, insulation that will withstand high perforation tests will usually have satisfactory ohmic resistance. Even a moderate rise in the temperature of rubber or paper insulations very rapidly reduces their resistance, as measured in megohms; but such rise affects the insulation comparatively slowly, in the way of decreasing its perforation point, unless high temperatures, particularly for rubber, say, 80 to 100 deg. C., are continued for some time when possibly chemical changes may take place. Thus, while this considerable change of resistance with moderate increase of temperature is of little importance in practical work, because the leakage loss would be an inappreciable amount of the energy being transmitted, it must nevertheless be borne in mind when making cable resistance measurements and locating faults.

Too severe high-potential tests may strain or weaken some of the less strong particles of the insulating material which may break down later under the normal working pressure; hence, moderate increase of potential, say 150 per cent of normal, should be applied for time tests upon the cable completely installed, but higher time tests, say 200 per cent to 300 per cent, and also tests for perforation should be applied on pieces 10 ft. or 15 ft. in length cut off for the purpose of testing. Cables will momentarily withstand much higher potentials than those which can be applied constantly; for example, a cable that will withstand double normal voltage should also safely withstand instantaneous application of five times the normal potential.

There is a very general lack of knowledge and wide difference of opinion among experts as to the constitution of the best insulation for high-tension work. No uniform specifications have been accepted for high-potential cables and have not been attempted herein. It may be said, however, that the engineers have generally agreed upon the following essentials:

For rubber insulation: (1) The compound should contain not less than 30 to 35 per cent of old "up-river Para" and no shoddy or reclaimed rubber or bituminous substitutes. The fact that it is almost impossible for any chemist to ascertain the actual percentage of pure Para in a compound indicates one of the difficulties involved in determining the purity of the insulation. (2) The vulcanization—subjection to heat after mixing with about 3 per cent of sulphur—must be done with the greatest care, otherwise the good results obtainable from the best rubber will be neutralized. (3) The insulation when complete must retain the proper mechanical qualities to insure vitality, durability and ruggedness.

For paper and cambric insulation: (1) The insulating material should be mechanically strong and applied in thin layers. (2) The layers should be wound evenly and tightly about the conductor. (3) Before the application of the impregnating fluid or varnish—which in either case should not be too viscous, otherwise brittleness will result—the conductor and its wrappers should be thoroughly dessicated.

Direct-Current Motors, Their Action and Control—X.

By F. B. Crocker and M. Arendt.

DIRECT-CURRENT SERIES MOTORS.

SERIES motors are of two general types, constant potential and constant current. The latter being no longer used commercially, attention will be paid chiefly to the former. As the name of this motor implies, the field and armature windings are in series, hence the

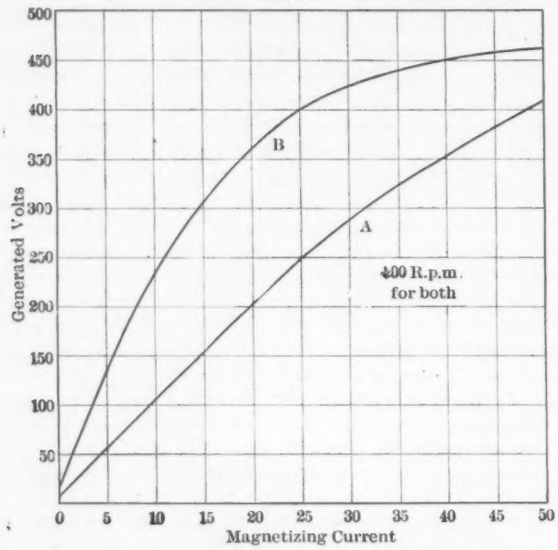


FIG. 1.—MAGNETIZATION CURVES OF SERIES MOTORS.

field excitation of this machine is proportional to the armature current. If it were not for saturation of the magnetic circuit and resistance drop of the windings, the speed would be inversely proportional to the amperes input, because r. p. m. $= \frac{E10^8 60b}{N\phi 2p}$ that is, the flux ϕ being the only variable would increase directly with the input in amperes. In practice, however, the magnetic circuit of a series motor is usually de-

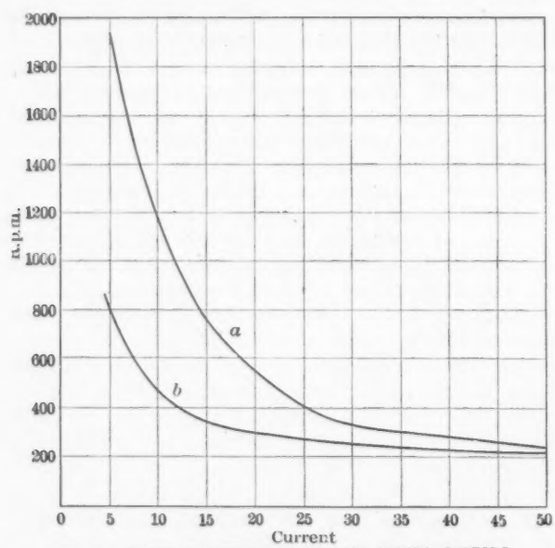


FIG. 2.—SPEED-CURRENT CURVES OF SERIES MOTORS.

signed so as to approach saturation at less than rated load, hence the speed varies (inversely) to a smaller extent than the variation of current. This relation between speed and amperes input is brought out numerically in the two following examples. The first assumes a series motor with a field of relatively low density and the second assumes a field approaching saturation below rated load:

A series motor (A) is run on a 550-volt constant potential circuit, with an armature resistance of 0.7 ohm and a field resistance of the same value. This motor is previously operated as a dynamo (separately excited), at a constant speed of 200 r. p. m. giving in terms of voltage generated the magnetization curve A in Fig. 1 with field current variations from 0 to 50 amperes. With this data, neglecting armature reaction (which is small since back ampere-turns are absent, brushes being always in the neutral position) and brush drop also, a small item at 550 volts, the speed-load curve can be calculated and the relation between speed and amperes input readily determined.

At five amperes input the voltage drop due to armature and field resistance is IR_a and $IR_{se} = 5\ (0.7 + 0.7) = 7$ volts, hence the c. e. m. f. generated $= 550 - 7 = 543$ volts. From Fig. 1, curve A, a field flux due to 5 amp produces at 200 r. p. m. an e. m. f. of 56.5 volts, hence to produce a c. e. m. f. of 543 volts, the r. p. m. $= \frac{543}{56.5} \times 200 = 1920$. The speed at other torque conditions corresponding to 10, 30, 40 and 50 amperes can be similarly calculated; the results being given in the following table:

CURRENT-SPEED DATA SERIES MOTOR A (LOW FLUX DENSITY).

Current Amps.	Vt.	$I\,R_a$	$I\,R_{se}$	c. e. m. f. $= V - I(R_a + R_{se})$	Volts at 200 r. p. m. Curve A. Fig. 1	R. p. m. $=$ c. e. m. f. / Volts at 200 r. p. m. $\times 200$
5	550	3.5	3.5	543.	56.5	(543 ÷ 56.5) 200 = 1920
10	550	7.0	7.0	536.	108.0	(536 ÷ 108.0) 200 = 1155
20	550	14.0	14.0	522.	200.0	(522 ÷ 200.0) 200 = 522
30	550	21.0	21.0	508.	283.0	(508 ÷ 283.0) 200 = 359
40	550	28.0	28.0	494.	350.0	(494 ÷ 350.) 200 = 283
50	550	35.0	35.0	480.	412.0	(480 ÷ 412.) 200 = 233

Plotting these speed and current values in the form of a curve, Fig. 3, and comparing the various values, it is seen that the speed varies almost inversely as the current.

In the case of series motor, B, the armature and field resistances are 0.4 and 1.0 ohm respectively, and the magnetization voltage curve of this machine operating at 200 r. p. m. with 5, 10, 20, 30, 40 and 50 amp field current is shown in Curve B, Fig. 1. The rated load current is 50 amp and line voltage 550 as in the case of machine A. The relations existing between current and speed can be calculated as in the case of the preceding motor, the results being given in the following table:

CURRENT-SPEED DATA SERIES MOTOR B (HIGH FLUX DENSITY).

Current Amps.	Vt.	$I_a\,R_a$	$I_a\,R_{se}$	c. e. m. f. $= V - I(R_a + R_{se})$	Volts at 200 r. p. m Curve B. Fig. 1	R. p. m. $=$ c. e. m. f. / Volts at 200 r. p. m. $\times 200$
5	550	1.	5	543.	137.	(543 ÷ 137) 200 = 794
10	550	4.	10	53.	235.	(536 ÷ 235) 200 = 455
20	550	8.	20	522.	360.	(522 ÷ 360) 200 = 290
30	550	12.	30	508.	420.	(508 ÷ 420) 200 = 242
40	550	16.	40	494.	450.	(494 ÷ 450) 200 = 220
50	550	20.	50	480.	462.	(480 ÷ 462) 200 = 207

Plotting the speed-current curves of machines A and B as in Fig. 2, the effect of low and high magnetic flux densities on the speed of the series motor at various loads is shown The type of direct-current series motors commonly employed is that with the higher flux density (curve B) on account of the greater economy of material, smaller bulk and better operation under conditions of variation in the line voltage.

Comparing the speed curves of series and shunt motors, it is apparent that speed changes in the series motor are due not only to $I\,(R_a + R_{se})$ effects, but more (up to heavier loads) to increase in field strength. The IR_a drop is greater in series than in shunt motors of the same rating, because the former machine is usually designed for intermittent service

so that the current density in the field and the armature circuits can be made much higher than would be approved of in the shunt motor. In fact the rated load of a series railway motor is usually accepted as that which will cause, after one hour operation, a rise in temperature of 75 deg. C. in the windings; while in the case of shunt motors, the rated load will cause a rise in temperature of not more than 50 deg. C. after from 6 to 18 hours' operation.

The torque, or turning moment, of a motor is proportional to the field strength and the armature current, or $T = K\phi I$. In a shunt motor ϕ remains constant from no load to full load (except for slight effect of armature reaction) hence the torque increases directly with the armature current, the curve between torque and amperes being, therefore, practically a straight line (see Fig. 3). In the case of the series motor until nearly rated load is reached, the field flux increases nearly in proportion with the armature current, the field being excited by the same current; that is, $\phi \propto I_a$. Hence $T = KI_a^2$, which shows that the current-torque curve is one of the second degrees until rated load is approached, when ϕ tends to become constant and beyond this point the torque increases approximately with the armature current. The curves in Fig. 3 are those of armature current and torque of shunt and series motors, respectively.

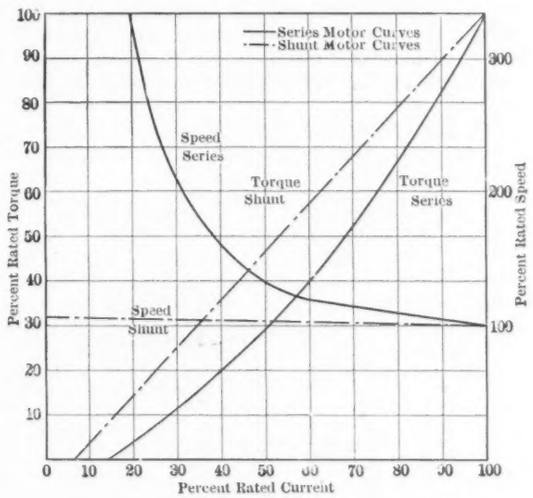


FIG. 3.—SERIES AND SHUNT MOTOR CURVES.

If the speed-ampere curve and ampere-torque curve of a series motor are compared as in Fig. 3, it is seen that maximum torque exists at minimum speed. This is the valuable feature of the series motor, as the maximum torque is obtained at starting with consequent rapid acceleration. The study of the curves in Fig. 3 also brings out the fact that maximum speed occurs at minimum load—a bad feature of the series motor, because of the danger that the machine will race if the load is removed or reduced below certain limits. For example, any load current below 30 per cent of rated current will give speeds more than twice the rated value. This feature is also indicated by the equation for motor speed; that is, r. p. m. $= \dfrac{E10^8 60b}{n\phi 2p}$; because when the motor load is heavy ϕ is large, also $I_a(R_a + R_{se})$ is large, thus to develop the necessary E (c. e. m. f.) the speed is a minimum. If, however, the load is removed, only sufficient current is drawn to overcome the stray power losses, so that ϕ is extremely small and $I(R_a + R_{se})$ is also small; hence to develop the given value of E the speed must increase greatly.

Armature Reaction in Series Motor.

The field strength of the series motor is not decreased by armature reaction in the same way as in the shunt machine, because the field ampere-turns increase directly with the increase of armature current. The strengthening of the field flux with increase of load maintains to a great extent the necessary flux for commutation, hence brush shifting is not necessary and field weakening due to back ampere-turns does not occur. In fact, the majority of series-wound motors are employed for railway or other service, wherein frequent reversal of motion is likely to occur. Hence such motors are provided with armatures of the two-circuit type, in order to require only two sets of brushes, which are securely held in a fixed position, so as to be properly set for armature rotation in either direction.

The principal applications of series motors are in connection

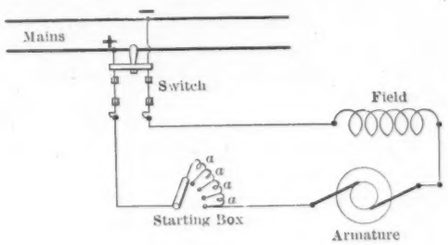


FIG. 4.—SPEED CONTROL OF MOTOR.

with those classes of work for which rapid acceleration under load is necessary, for frequent starting, stopping, as well as reversing, and where the motor speed must be automatically adjusted to the load, as, for example, in traction, hoisting, pumping, and ventilating services.

Speed Control of Constant-Potential Series Motors:

1. Rheostatic.
2. Shunting of field circuit (field weakening).
3. Series-parallel connection of two or more motors.

The simplest speed control of a series motor is that effected by placing an external rheostat in series with the motor circuits, the resistance of which is varied according to the required torque and speed. This is similar to the rheostatic method of speed regulation employed for shunt motors and possesses the similar disadvantage of low economy, but not to the same extent because the field flux increases with heavy loads and low speeds. With another method, represented in Fig. 4, the field circuit is shunted or the field coils are arranged in parallel; its principle depending upon the equation $r.\ p.\ m. = \dfrac{e\,10^8\,60b}{\phi n 2p}$ in which ϕ is varied the same as for a shunt motor whose speed is controlled by field weakening. The objection to this method is the increased tendency to sparking at the brushes with the weakened field, so that it was formerly employed only as one step in the series-parallel control of series motors; but since the

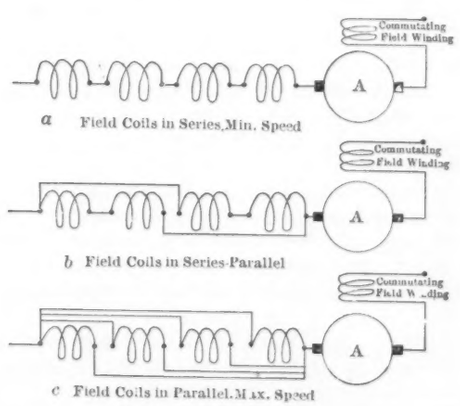


FIG. 5.—SERIES MOTOR WITH INTERPOLES.

introduction of interpoles, which maintain a commutation flux increasing with the load, series motors are being developed which are entirely controlled in this way after having been started with external resistance in series. The advantages of this scheme are wide ranges of speed and greater economy of control than with the series-parallel arrangement, the diagram of connections being shown in Fig. 5.

Care and Operation of Transformers.

By Fred. Dubell.

A GOOD transformer, if properly installed, connected to a load within the requirements of the guarantee and well protected from lightning and static disturbances on the line and possible severe overloads, will remain in service and require no attention except for a systematic inspection, which should be kept up by every central station. The inspection should consist of an examination of the leads, transformer temperature and of lightning arresters on the line. The benefit derived by both the station management and the public will more than repay the extra expense of instituting such an inspection. A defective lightning arrester will cause a burnout of a transformer. Transformer leads exposed for long periods to the weather are likely to become bare of insulation and come in contact with the case, connecting the high-voltage to the low-tension winding. Such possibilities of fatality that may cost customers their lives, and the operating company expense for damages, will be done away with under a rigid system of inspection. Safety of the customer should always be the watchword of those entrusted to some extent with the lives of the citizens, and on this account no pains shall be spared to fulfill the obligations to the public.

Whenever changes are made on the line, and transformers are shifted from one locality to another, it is advisable always to bring them to the testing rooms, and no transformer should be allowed to be taken out unless provided with an "O. K." tag indicating that it has withstood the required test and is in good condition for service. The testing department should keep a full record of all transformers. The following table is a copy of a card made up by the writer for use in such a testing department:

TRANSFORMER RECORD.

Transformer No.		Rating.	
Prin. Res.	Ohms.	Sec. Res.	Ohms
$I_1^2R_1$	$I_2^2R_2$	Guar. I_2R	% Var.
Core loss tested	Guar.	% Var.	Total % Var.
Imp. Watts	Imp. Volts.	Regulation	
Exc. Cur.	Power factor	Ratio-Polarity	
Eff. full-load		Eff. all-day	
Prim. to core at V.		Sec. to core at V.	
Prim. to Sec. at V.		X nor, V.	
Prim. Insul.	Sec. Insul.	Cond. of leads	
Heat run		Date	
Tested by	Checked by	Approved by	

If the transformer was subjected to a complete test when installed the only additional tests necessary when it is returned to the station are those for ascertaining reliability of the insulations between the primary and secondary coils and the insulation between the primary winding and core, and between the secondary winding and core. Moreover, it is advisable to observe the exciting current and core loss at the operating voltage and normal frequency in order to enable one to note the changes in the magnetic properties of the core.

Next in importance to the safety of the transformers is the efficiency. In some of the old-type transformers the iron ages to such an extent as to make their use detrimental to the economy of the station. The risk of a breakdown under conditions of high temperature is great, and out of consideration for safety and efficient operation such transformers should be discarded.

The oil which is now almost universally employed in transformers performs two duties. In the first place it acts as a cooling medium for carrying the heat away from the interior to the transformer tank, which dissipates the heat into the surrounding atmosphere; in the second place, it takes care of static brush discharges, filling in the puncture made by these discharges and thus healing the defects caused by them. In view of the importance of oil as an insulating medium in transformers, it is essential that the oil should be of the best quality obtainable. While every transformer manufacturer claims that the oil he uses is the best on the market, the customer will do well to subject the oil to a dielectric test. The dielectric test alone is sufficient, as it will always detect defective oil, whether the defect be due to moisture, water, acid or other foreign matter. Oil between an adjustable spark-gap immersed in a glass vessel and set for ⅛ in. should withstand a pressure of 20,000 volts and no oil should be allowed in transformers which will not withstand a disruptive e.m.f. of 15,000 volts. The effect of moisture on the insulating properties of oil is shown in the curve, Fig. 1. As shown in the curve, as little as 0.06 per cent of moisture will reduce the disruptive e.m.f. from 10,000 to 4000 volts.

The oil-cooled type of transformer is manufactured in ratings up to 175 kw, but larger units are often provided with cooling devices having water circulated in pipes immersed in the oil. By this artificial means the size of apparatus is kept down, as efficient means are provided for carrying away the heat dissipated in the iron and copper. This latter type of apparatus is becoming the standard for high-voltage work. Whenever the e.m.f. does not exceed 25,000 volts many engineers prefer to specify air-blast transformers, as in this case it is not essential to keep them in separate fireproof compartments, and the arrangement and wiring of the station is greatly simplified. In the last two types the successful operation of the apparatus depends on artificial cooling, and it is well to have duplicate means provided for this cooling. In case of the oil-insulated, water-cooled transformers means must be supplied by which a duplicate source of water circulation is accessible. With air-blast transformers, two sets of motor-blower units should be installed, both of them at the same end of the air chamber, so as to allow their operation at the same time whenever emergency may require.

In the case of oil-insulated transformers, special piping

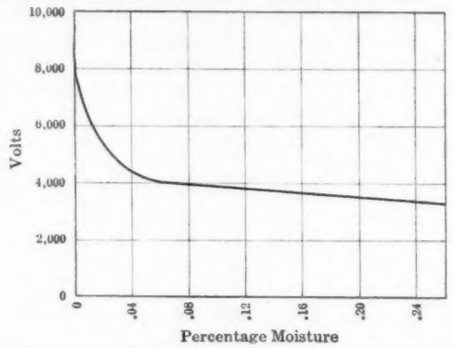


FIG. 1.—RELATION BETWEEN BREAKDOWN VOLTAGE OF OIL TO PERCENTAGE OF MOISTURE CONTAINED.

should be provided, by which, when the transformer is on fire, water can be admitted into the transformer at the bottom of the case, forcing the oil out through a pipe in the top of the case and into the sewer. Oil transformers should always be enclosed in separate fireproof compartments, and means provided by building an external case around them, by which the transformer can be entirely immersed in water if threatened by an external fire, as that of the building. Another important feature in using water-cooled transformers is that of having a gage which will help in discovering any water that may accumulate in the bottom of the transformer tank through a defective water coil.

Automatic devices should be installed in the instance of the water-cooled and air-blast transformers which will enable the station operator immediately to disconnect a transformer with a leaky water pipe, or to prevent the spread of fire from one air-blast transformer to another. Signal bells can be wired so as to warn the station man of the approaching danger of the water leaking into the transformer. Two leads placed close to the bottom of the glass gage when connected with a column of water will complete the circuit and ring an alarm bell. A gate should be placed underneath each air-blast transformer so that in case of fire the blast can be immediately shut off without interfering with the safety and operation of any other unit in the same station.

Occasionally trouble in water-cooled transformers is attributed to leaving water in the pipes when the transformers are

taken out of service. It is important whenever the apparatus is disconnected that the water should be completely removed, as otherwise in cold weather the water may freeze and burst the piping, thereby resulting in the destruction of the winding. If the presence of water is discovered in the oil, the water and oil should be completely removed and the coils heated electrically long enough to restore the insulation resistance to a safe value. New oil should be used to refill the case, but if this cannot be had conveniently, the water should be drained off and then the oil should be heated until all the moisture is driven out.

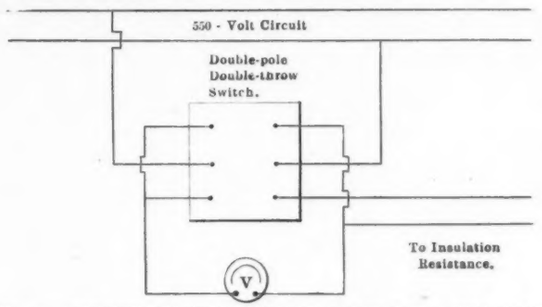


FIG. 2.—CONNECTION FOR MEASURING INSULATION RESISTANCE.

In this connection it may be well to dwell more at length on the method of drying electrically by a short-circuit. The baking by external heat should be resorted to only when it is impossible to improvise means for baking by the internal heat of the coils proper. In transformers of large rating where the cooling is effected either by a blast of air or by water circulation, the e.m.f. necessary to force full-load current through the coils will amount to approximately 2 per cent of the full primary voltage; in the smaller sizes the impedance voltage would vary from 3 to 5 per cent of the full voltage. In the case of a 10,000-volt transformer, 200 volts applied to the high-tension terminals will cause the flow of the normal current in both the primary and the secondary windings when the low-tension winding is short-circuited. It will be found, however, that the full-load current will heat the transformer too much; if the temperature characteristics of the transformer are not known, lower voltages should be applied and a fraction of full-load current should be used on a preliminary trial. The thermometer temperature should not be allowed to pass beyond 90 deg. C. (200 deg. Fahr.). The drying-out should be continued until the insulation resistance has reached its maximum.

The resistance of the insulation may be measured by the aid of a 600-volt voltmeter. The transformer coils should be connected to one side of a direct-current circuit in series with the voltmeter on one side of a double-pole, double-throw switch; across the circuit, on the other side of the switch, the meter should be joined as shown in Fig. 2. With constant impressed potential take two readings, first of the line voltage with the switch up, and, second, the voltage as read on the meter used with the insulation resistance in series with switch down. Then using the following notation:

V = line voltage.
W = voltage reading when insulation is in series with meter.
R_m = resistance of voltmeter.
R_i = resistance of insulation.

The insulation resistance will be expressed as follows:

$$R_i = \frac{R_m (V - W)}{W}$$

The insulation resistance will gradually increase as the drying process continues until the maximum is reached.

Whenever transformers operate in parallel it is absolutely necessary to insure that they divide the load equally if of the same rating or proportionally if of different ratings. Too much reliance should not be placed on the manufacturer's claim as to what certain apparatus will do. Before transformers are put in multiple their impedances should be determined, and under no circumstances should use be made of transformers that will not divide the load within 2 per cent of proportional ratings of the transformers. Besides making sure of the impedance of transformers, the ratio and polarity should be checked. The ratio of all transformers used in multiple should be correct within ¼ per cent, as otherwise there will be excessive circulation of currents between the transformers. The polarity of all transformers should be the same, as otherwise the transformer of reversed polarity will be short-circuited on the rest of the transformers in the bank.

In every station operating air-blast transformers compressed air should be accessible for the purpose of blowing out the dust from the transformers, which should be done every week if possible; the accumulation of dust is likely to lead to grounds and result in the destruction of the apparatus. Considerable precautions must be taken in using compressed air, as no moisture should be allowed to pass with the first rush of air from the tank; the air should always be permitted to discharge freely for some time before being forced into the transformer. For minimizing the amount of dust settling in the transformer protecting screens in the air chamber are of great benefit. For safety of operation, the cases of all transformers kept within the station should be well grounded. For the safety of the customers, all secondary coils of service transformers should be grounded at the natural point.

Induced Draft—III.

By W. H. WAKEMAN.

IN a previous article it was shown that a very high rate of combustion is wasteful of fuel and that if one or two boilers are added, thus increasing the heating surface, the temperature of the gases may be reduced to an economical point.

Fig. 1 illustrates a battery of four tubular boilers used to generate steam in the usual way; and it is assumed that a pressure of 150 lb. is carried. The flue gases must have a temperature of not less than 366 deg. Fahr., corresponding to the temperature of steam at that pressure, but the temperature of the flue gases must be much higher, in order to make an economizer profitable, and for the purpose of illustrating the desired condition it is assumed that the temperature is 465 deg. Fahr., although it is higher in many cases. The dampers 2 and 3 are closed, therefore these gases pass the open damper 4 and, following the passage shown, come to the economizer 5, through which the feed water is pumped on its way to the boilers, and here they part with a portion of their heat. Passing the open dampers 6 and 7, they arrive at the fan 8, which is the prime

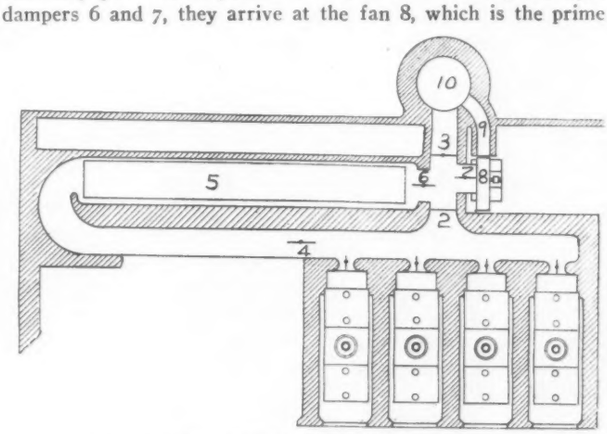


FIG. 1.—TUBULAR BOILERS AND ECONOMIZER.

mover in this case, sending them through the passage 9 to the chimney 10. If the economizer 5 is to be laid off temporarily for cleaning and repairs, the dampers 4 and 6 are closed and 2 is opened. If the economizer is to be used with natural draft only, then dampers 2 and 7 are closed and 8 is shut down, while 3, 4 and 6 are opened. When natural draft is not strong enough to permit the economizer 5 to be used, then 4, 6 and 7 are closed and 2 and 3 are opened.

The report of a certain test made to prove the value of an economizer shows that gases went into it at 465 deg. Fahr. and

came out at 250 deg., while water went in at 180 deg. and came out at 295 deg., therefore a reduction of 250 deg. in the former resulted in an increase of 115 deg. in the latter, making a saving of more than 11 per cent. Of course, water must enter the economizer where the gases leave it, and come out where the gases enter, in order to secure such satisfactory results, but a greater saving can be made where more heat escapes to the chimney without the economizer. The idea that it is absolutely necessary to use mechanical draft with an economizer is not

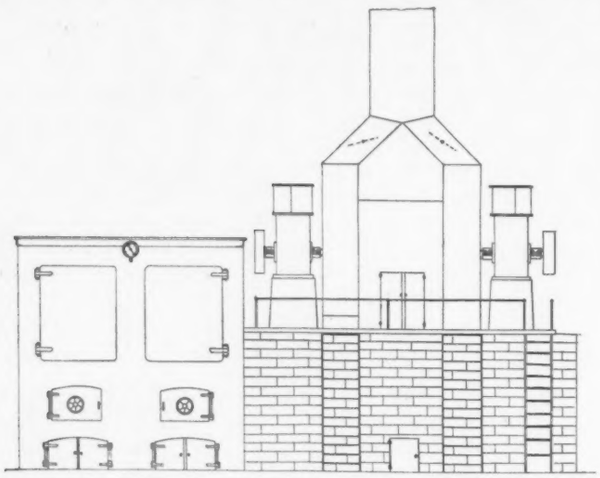


FIG. 2.—TUBULAR BOILERS EQUIPPED WITH INDUCED DRAFT FANS.

strictly correct, although it is often advisable, but if there is a very strong natural draft it will answer every purpose.

Conservative engineers do not favor the idea of equipping a plant with induced draft apparatus (including a short stack or chimney that will carry the hot gases and smoke above the roof, but is utterly useless for natural draft) and have only one fan to force the circulation of heat, for if that fails the whole plant must be shut down until repairs are completed. This does not necessarily mean that such a fan, including the driving mechanism, is any more liable to fail than other parts of the machinery, but every minor part of a plant should be duplicated, as it is always a paying investment. For illustration of this point, a plant should never be wholly dependent on one

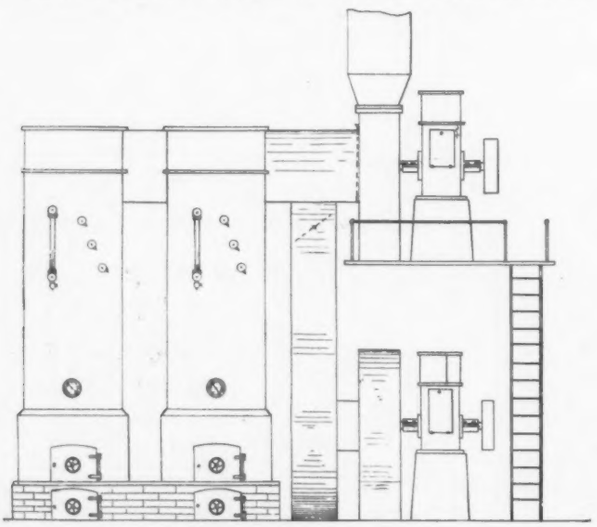


FIG. 3.—DUPLICATE FANS FOR VERTICAL BOILERS.

pump to feed the boilers, as there should at least be an injector that is large enough to deliver the maximum amount of water required per hour, and it ought to be kept in good order, ready for instant use.

Fig. 2 illustrates a battery of tubular boilers equipped with two fans, which may be used together and run at a low speed or one can be run at a higher rate while the other is shut down. The products of combustion are discharged into a chamber built for this purpose, which is large enough to allow the heavier particles of soot and ashes which pass through the tubes to settle to the bottom, whence they can be removed at slight expense.

Fig. 3 illustrates a similar device applied to a battery of vertical boilers, hence it becomes natural to locate one fan above the other, because the boilers are very high, thus bringing the smoke-pipe about 20 ft. above the boiler room floor. The machinery occupies but little floor space, and one engine can be cared for without leaving the floor. The lower fan draws the hot gases down through the connection shown and discharges them into another pipe (not shown) connected with the chimney.

Steam engines that are used to drive fans for induced draft should be simple in design, of strong construction and fitted with lubricating devices that require minimum attention. They ought not to be run at high speed in regular service, because they seldom receive the care that high speed calls for in order to prove successful. The belted engine is preferred by some

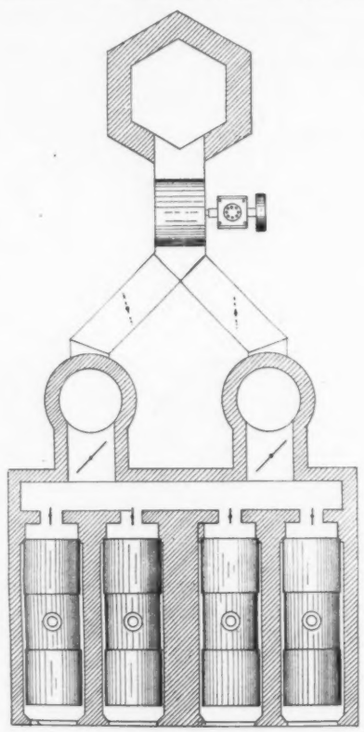


FIG. 4.—ARRANGEMENT FOR UTILIZING WASTE HEAT.

engineers on this account, because the direct-connected engine must run as fast as the fan, but there is no good reason for this prejudice, as it is practical to design a fan that will do the required work in a satisfactory manner at moderate speed.

Fig. 4 is a suggestion concerning the use of induced draft in rolling mills and other places where large quantities of waste heat can be used if provision is made for it. In some rolling mills heat is allowed to escape from the furnaces directly to iron stacks, and the temperature is so high and the quantity so great that flames pour out of the tops of these stacks. Where more attention is paid to economy in operation horizontal boilers are set so as to receive heat from the furnaces, and four of these are shown in the illustration.

The temperature of gases as they escape from these boilers is high, hence two vertical boilers are set so as to receive this heat and use it in evaporating water. This still further reduces the temperature of the gases, so that they can be handled by a fan driven by an independent engine, which sends them to a large chimney. The fan would probably be necessary, because heat must pass through long and crooked passes, which create friction and prevent rapid motion of the products of combustion, unless mechanical means are provided for forcing them forward, and this is a very practical way of doing it.

LETTERS ON PRACTICAL SUBJECTS

HANDLING COAL AND ASHES.

The problem of handling coal and ashes in the boiler rooms of small power plants will continue to be a vexatious matter as long as the small isolated plant exists. In large power installations the problem has been pretty well standardized by the use of the V-bucket elevator and conveyor and the "close contact" pivoted bucket carrier. The former acts as an elevator for vertical carrying and the same buckets act as scrapers in a trough for the conveying portion of the work. The latter-named apparatus consists of buckets which remain right side up with care at all times, whether elevating or conveying. This is the better apparatus of the two, but it costs a little more than the V-bucket arrangement.

There are other systems, among which may be mentioned the mono-rail conveyor, in which a belt conveyor is carried on a sort of merry-go-round with no strain upon the belt except that due to the weight of the material to be carried. In fact, the device somewhat closely resembles a troughing belt carried on a one-legged moving platform. This arrangement is carried with ease around curves up to 180 deg., and it will run up-hill to 23 deg. It will not, however, convey and elevate, as will the two arrangements first mentioned.

The troughing belt is used to advantage in handling coal in some power houses, but separate arrangements must be put in for handling ashes and coal, as the same belt does not take kindly to both as is the case with the V-bucket elevator-conveyor and the pivoted bucket layout, both of which are usually arranged in a complete circuit over and below the coal storage and the ash pits, and serve to handle either material at will.

The large power plant is, therefore, well provided with means for handling both coal and ashes without manual labor, and it is the small plant with one to four boilers which needs labor-saving coal and ash-handling apparatus. It may appear at first sight that where only two or three tons of coal a day are to be handled not much saving can be effected by the use of coal and ash-handling apparatus. Where the fuel bill is but $9 or $10 a day it does not seem possible to save much, but with a coal-handling and ash-removing installation the fireman may be dispensed with in many small plants, the engineer being able, with the assistance of the stoker and coal and ash-conveying machinery, to run the entire power plant without discomfort.

If, then, the small power plant is to have a coal-handling layout, of what shall it consist? The usual coal-conveying machinery in small plants consists of two barrows, one for coal, the other and larger one for ashes. Any man who has ever used the wheelbarrow will appreciate the crudeness of that method of conveying and will welcome anything in the labor-saving line. If the fireman could only prevail upon the superintendent of the station to wheel coal and ashes for one day, he would never have to ask but just once for the most improved form of coal and ash-handling machinery. And if the fireman could only prevail upon the superintendent to clean a fire and take out the ashes just once, there would be no need of asking for rocking grates of the latest pattern, and an ash-carrier would be installed the very first Sunday.

The automatic stoker will quickly pay for itself in saving of coal upon the smallest furnace—even upon dryer furnaces the stoker has been found profitable, where less than 1000 lb. of coal is consumed each day. With an automatic stoker, it is not much of a task to arrange some sort of overhead hopper which will permit coal to flow by gravity to the automatic stoker. Even when the bulk of the coal storage must be on the ground, a bucket elevator to the small overhead bin is not costly and it permits the engineer to keep a supply of coal in the hopper at all times with only the labor of dumping it into the elevator boot.

Several arrangements of this kind, as installed by the writer, had the coal storage adjacent to the elevator above described and extending to a considerable distance when a year's supply of coal was at hand. Several teams were employed in connection with the power house and one pair of horses were attached to a scraper for 10 minutes each day and the required amount of coal for the day's run was brought to the elevator, thus leaving nothing for the engineer to do in handling the coal except to start the elevator occasionally and to trim into the boot the coal which had been scraped to the elevator. After a while the hopper into which the elevator discharged was increased in size to contain a full day's run of coal, and the scraper delivered all the coal directly into the elevator boot, which took care of the coal as fast as it was brought along.

The ash removal and disposal thus becomes a separate proposition and may be taken care of in a variety of ways. The Mississippi steamboat man has a mighty good idea of the fitness of things when he arranges the bottom of the ash pit as a steel-lined sluiceway through which at all times a small centrifugal pump causes a stream of water to flow from the river only a foot below the bottom of the ashpit. Every bit of ash or clinker which fell into the watery ashpit was quickly rushed overboard and that was the last of it. But that scheme would not work as well on boats in harbor waters, where the laws are very stringent against dumping ashes or other refuse overboard within certain limits. But the scheme seemed so good and sensible, and the ashpit was at all times so cool and clean, that the idea was enlarged upon to fit a power plant. A pit was excavated below the boiler and the sides concreted and made V-shaped and lower at one end of the V than at the other end. At the lowest point a continuous-bucket elevator was installed and fitted to discharge into a tank wagon, which in turn was equipped with an overflow pipe, which discharged into the ashpit. In two instances, the ashes had to be discharged upon a city sidewalk and previous to the installation of the tank vehicle complaints of dust had been numerous and prospective damage suits were in sight. In these cases, an extension sidewalk elevator was put in. This device collapsed into a hole in the sidewalk when not in use and was quickly raised into position for the few moments required to remove the ashes and clinker. Upon starting the elevator, the tank wagon was quickly filled with ashes and water, most of the former settling to the bottom, the latter passing off through the overflow and returning directly to the ashpit. The bucket elevator proves to be a good pump, and the valves never stick or leak. Consequently quite a circulation of water was caused and maintained in the ashpit and the solid matter which happened to be therein was quickly washed down into the elevator, which broke up the larger lumps or pieces until they were finally reduced to fragments, which were landed in the tank-wagon.

In one case, the ashes were dumped into a river instead of into the tank-wagon, and this continued until stopped by complaints from down-the-river land owners, who objected to deposits of coal ashes along their riparian property. That stopped the river dumping, but the wily manager then let the elevator dump the ashes on the bank of the river and commenced to grade a bit of made land. It was not his fault that the spring freshets washed all the made land away every spring, in spite of the flimsy crib-work erected to hold the ashes in place. It was more than 10 years before that electric-light station succeeded in filling a grade 20 ft. square back of its buildings, but then it did not cost anything to dispose of the ashes and as they all went down-river to parts unknown and never lodged against the property of adjacent river neighbors, there was no complaint made.

New York City. James Francis.

EQUIPPING AN OLD MACHINE SHOP WITH MOTORS.

The writer has recently been studying the very interesting problem of installing motor drives for a lot of iron working tools in a machine shop. There was a heterogeneous lot of tools, of almost every known variety and make, and the problem was to attach a motor to each machine or group of machines to the

best advantage possible. There was no chance of using induction motors, neither could multiple voltage speed control be instituted, for the reason that 220-volt generators were on hand. The generators were installed in the existing engine room, which had contained an obsolete slow-speed engine of tremendous size, and which vacated room enough for the several direct-connected and belt-driven generators in the outfit provided. With the installation of the engines and generators, little need be said. A lot of the lathes and some drill presses were so located that they could be driven from a long shaft extending the length of the shop along the wall, but the larger machines were all arranged to be driven with independent motors.

The means of attaching the motors to the various tools were as many, almost, as there were tools. Two large planers had brackets bolted to the upper portion of the framework, and the arms thus attached, projecting upward, carried a countershaft upon which were placed the several pulleys necessary to drive the various moving parts of the machines. Another planer had a pair of web brackets attached to the top portion of the housing, and the upper parts of these brackets were floored over and the motor placed on top, the motor being back-geared to a countershaft which carried the necessary driving pulleys.

A large radial drill was fitted with a bracketed shelf overhead for the motor, and connection was made direct to the shaft of the drill by means of some silent chain. Another large machine, which stood between two iron columns of the building, had a countershaft fitted with three bearings, one of which was bolted to each of the columns, while the third bearing was carried by a casting bolted to the top of the column of the machine itself.

A smaller drill press was fitted with a motor placed on the floor close beside the drill, and belted to a countershaft immediately over the drill. An inverted bracket served to sustain the countershaft, the bearings of which were carried in drop hangers bolted direct to the 2-in. plank which formed the flooring of the brackets. The wiring for all these motors, instead of being concealed by running it beneath floors or along walls and posts, was run by the shortest route to each motor or starting box, and passed along the floor in many cases. Every wire was run separately in flexible metallic conduit, and the workmen walked over the wires and in many instances tumbled tools and castings over the conduits, proving that the system is a most practical one to use, although costing more than a system in which both wires run in the same conduit.

One of the motors which was installed in the shop above described soon developed severe sparking at the brushes. So bad did this become that it was necessary to send for a new armature for the motor. After much discussion on the part of various experts, the cause of the trouble was located, and a very simple trouble it was found to be, after all. The mica insulation between the commutator bars had crumbled away, leaving deep spaces between the commutator segments, or bars, across which the brushes wiped, or drew, small arcs which constituted the "sparking" that was so troublesome. A new commutator on the old armature made that appliance as good as new.

Erie, Pa. John Rogers.

PROBLEM IN LAMP WIRING.

I submit the following solution of Mr. C. M. Johnson's problem in lamp wiring, found on page 524 of the September number. The conditions specified in the problem are as follows: Lamp *A* and switch 1 are on the first floor, lamp *B* and switch 2 on the second floor, lamp *C* and switch 3 on the third floor, lamp *D* and switch 4 on the fourth floor. It is desired to have switch 1 light lamps *A* and *B*, switch 2 extinguish lamp *A* and light lamp *C*, switch 3 extinguish lamp *B* and light lamp *D*, and switch 4 extinguish both lamps *C* and *D* as a person goes upstairs. They are to be wired so that a person descending can control them in reverse order from that outlined for a person ascending. As shown in Fig. 1, this requires the installation of two wires from the first to the fourth floor, two

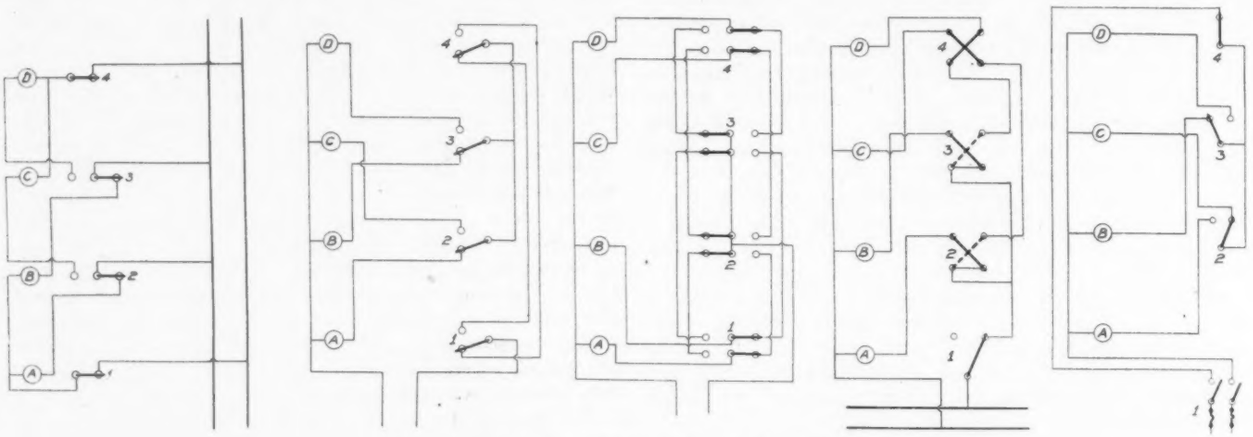


FIG. 1, 2, 3, 4 AND 5.—SOLUTIONS OF WIRING PROBLEM.

single-pole, single-throw switches and two single-pole, double-throw switches. Let switch 4 be closed and switches 3 and 2 be thrown to the right. A person entering the hall on the first floor closes switch 1 which lights lamps *A* and *B*. He now ascends to the second floor, where he throws switch 2 to the left, which extinguishes *A* and lights *C*. Next he ascends to the third floor, throws switch 3 to the left and light *B* is extinguished and lamp *D* is lighted. Finally he ascends to the fourth floor, where he may open switch 4 and thus extinguish lights *C* and *D*. In descending switch 4 is closed and the switches on the other floors are thrown in opposite positions from those they occupy. Switch 1 is opened as the person leaves the building.

Schenectady, N. Y. F. C. Helms.

I enclose herewith a diagram (Fig. 2) of wiring and switches necessary to control lamps as per problem in the September number. Such an arrangement has several disadvantages while possessing no advantages over the usual three-way and four-way switch wiring, in that it is necessary to make a trip to the fourth floor and return to leave the switches in position for the next person. To stop off on the top floor would leave the switch on the first floor inoperative. The only advantage, if it could be considered one, would be the saving in energy in cutting out the lamps on the lower floors. A regular combination switch arrangement with three-way switches on the first and fourth floors and four-way switches on the second and third floors would permit of leaving or entering the hall on any floor and operate the lamps either way regardless of the position of the switches. In the diagram four three-way switches are employed, and in the position of the switches shown all lamps are cut out of circuit.

St. Louis, Mo. C. J. Sutter.

The enclosed diagram (Fig. 3) gives a solution of the problem in lamp wiring printed in the September number; double-pole, double-throw switches being used. In the position shown all lamps are out of circuit. In order to make the circuit complete, it should be wired so that a person on any intermediate floor could light the lamp on the floor above or below and extinguish that on the floor below or above, the lamp on the intermediate floor being lighted in each case, or extinguish lamp on floor above or below and extinguish lamp on intermediate floor. I suggest this as an additional problem.

NEW YORK. C. H. POOL.

Enclosed find diagram (Fig. 4) of switch control for hall lamps as outlined by Mr. C. M. Johnson, Jr., in the September number. There may be other ways to accomplish the desired results; but as the diagram enclosed covers the ground, it will suffice. I do not consider the outfit as shown of much practical use because if any switch were turned on out of regular rotation, it would necessarily throw the system out so far as the operation of lamps, as outlined, is concerned.

PHILADELPHIA, PA. V. M. CRUIKSHANK.

Fig. 5 herewith gives a solution to Mr. C. M. Johnson's problem in the September number. One standard double-pole switch is used as switch 1, standard three-way switches are employed for switches 2 and 3, and a single-pole switch is used on the fourth floor. The diagram shows the switches set to light lamps *B* and *C* and to extinguish lamp *A*.

NEW YORK. H. A. DRESBACH.

NEW CONDUIT MATERIALS AND THEIR POSSIBILITIES.

In the immediate future considerable attention must be given to two forms of nearly the same substance for electrical conduit work. The substances in question are concrete and sand-lime. The first-named is supposedly well known to engineers; the other form of material—"sand-lime"—is known to some engineers in the same superficial way that concrete is known. In both concrete and sand-lime, where is the engineer, or the manufacturer, who can predetermine from tests (entirely mechanical) of the sand, gravel or broken stone and the cement, what will be the strength and percentage of absorption of the finished product?

It is quite possible thus to foretell the characteristics of any make of concrete, the proportion of the fine and the coarse material being known. But who and where are the engineers who have studied this phase of concrete? The usual method of mixing that material is according to some empirical formula —1-2-3, or 1-2-4, etc., no matter what may be the nature of the "1" or the "2" or the "4." By thus taking the elements of concrete as nature gives them, is it to be wondered at that the concrete block and the sand-lime brick run through all degrees of strength and porosity?

When nature presents the grades of sand and coarse material which are required to make strong impervious concrete, then the blocks or other shapes are all that can be desired, but when the natural materials vary from the required proportions, then we have the "horrible examples" of concrete which are only too numerous on every side. It is this disregard of the natural laws of concrete which causes the failure of the reinforced concrete structure, and which causes the architect to condemn or to ignore the concrete block. Yet this same material is capable of making most excellent blocks, and it can also be formed into pipes for every purpose. For conduits through which electric wires are to pass, concrete offers advantages which cannot be ignored by engineers, once these engineers are made aware of the facts of the case.

As the matter now stands, concrete conduits may be made of such solidity that they will stand 3000 lb. to the square inch of solid section, and absorb less than 6 per cent of water without any reinforcing or waterproofing, and with but 10 per cent of cement in their ingredients. Such conduits may be strengthened as desired by the addition of wire reinforcing, or by filling them with asphalt or with one of several other substances, the absorption percentage may be entirely eliminated. A large corporation is about to engage in the business of making conduit and other pipe of concrete and possibly of cement mortar. This concern has before it the possibility of success with the probability of failure. Its success or failure will depend entirely upon its knowledge and observance of the laws which govern the proportioning of concrete.

Concrete may be made into conduit pipe of any desired shape or size, either by pressing or tamping. The possibility of making good conduit pipe by pouring is not worth considering. The hardening of concrete is caused by chemical action—crystallization—and it must have the presence of water in order to obtain its maximum hardness. Time to the extent of 28 days is necessary for the hardening of concrete, and moisture must be present in sufficient quantity during this period. By a steaming process, after the first 24 hours subsequent to molding the conduit pipes, they may be hardened in a few hours to the extent that they would harden naturally, in moist air, during 28 days. Concrete hardness, the question of moisture presence being the same in any instance, is the resultant of ordinates and abscissa which bring the curve to approximate a parabola. This being the case, the concrete is therefore always hardening. It hardens forever, and never gets quite to its full strength. The hardening principle of concrete seems to be in the calcium and silica contained in the cement, and also, to a certain extent, upon the alumina, or clay, also contained therein.

Sand-lime products may be used for any purpose in the line of isolated pieces, for which concrete can be used. That is, sand-lime may be used for any small articles which can be steam hardened, but not for large masses which cannot be placed inside the hardening cylinder. Sand-lime mixtures should be made exactly like mixtures for concrete, except that the cement is omitted and in place thereof, 10 per cent of hydrated lime is used. If desired, from 5 per cent to 7.5 per cent of raw lime, calcium oxide, may be used and mixed in a finely ground condition with the sand, but this lime must be thoroughly hydrated before the mixture is pressed or rammed into conduit pipe or into any other finished product.

The hardening of sand-lime is apparently effected by recrystallization also, but it will not take place except under pressure at a high temperature. This may be on account of the absence of the clay element from the cementing ingredients, otherwise the hardening action which takes place in the presence of steam seems the same as that of cement. Sand-lime products also harden after removal from steam pressure, but, unlike concrete. the action is not infinite, neither is it due to crystallization, but to the recarbonization of the calcium hydrate which may remain in the product after as much calcium silicate as possible has been formed during the steam-hardening. The remainder of the lime takes up carbonic oxide from the atmosphere, which slowly reaches the uncombined lime in the product. This secondary hardening process is similar to that which takes place in lime mortar in which bricks have been laid—that is, the burned lime goes back again to calcium carbonate or ordinary limestone.

Conduit pipe may be readily made of sand-lime mixture and hardened in a few hours, the entire process of mixing, pressing and hardening requiring only about 24 hours from the sand-bank to the hardened pipe. But, as with cement conduit pipes, a waterproofing operation will be necessary which requires the pipes to be dried and then dipped, while hot, in asphalt or some similar waterproofing substance. Sand-lime products may readily be made with but 5 per cent to 8 per cent absorption, according to the grading of the fine and coarse material used. In fact, the absorption of concrete and sand-lime, also its strength, resembles concrete so much that there is little choice between them for conduit-pipe material.

The principal difference between the two materials lies in the cost and in the hardening treatment. The concrete requires the use of 10 per cent of expensive cement, while the sand-lime requires 10 per cent of cheaper lime, but requires the

use of the steam-hardening cylinder and steam enough to keep the pressure up to 150 lb. by gage for eight hours. There is also another point which must be taken into consideration. The concrete under air hardening treatment requires at least 28 days of constant wetting and protecting from wind and sun. If the concrete be steam hardened to fit the pipes for use within a few days, the same steam treatment is necessary that was given the sand-lime, hence that material is cheaper than the concrete by the difference in cost between the required quantity of hydrated lime or Portland cement.

The electrical conductivity of concrete or sand-lime—there is little difference between them—is about that of ordinary terra cotta, Indiana sandstone or similar materials. Once the bitumen or asphalt waterproofing is applied the resistance electrically is greatly increased. Pipes made from either concrete or sand-lime will be perfectly smooth, both inside and outside, and there is not the least distortion during the steam hardening process. The articles all come out of the hardening cylinder in exactly the same shape as when they went in. There is absolutely no distortion, as is sometimes the case with terra cotta or with vitrified clay products.

The worst feature in the process of manufacture with either concrete or sand-lime lies in the very tender condition of the articles immediately after they have been molded or pressed. It is necessary to handle either with the greatest care lest the corners be broken off. Yet so strong is the sand-lime, even when first pressed, that a 200-lb. man may step upon a brick of sand-lime, fresh from the press and laid upon the floor, flat side down, without in the least injuring or marking the brick. The whole weight may be placed upon the brick as above, if care be taken not to touch an edge or a corner of the brick.

Sand-lime is not an expensive material. It consists of about 90 per cent of silica sand, 7½ per cent of lime, and 2½ per cent of water, chemically combined. The density of the material will vary between 140 lb. and 160 lb. to the cubic foot, accordingly as it is graded, rammed or pressed. The cost of the manufactured material, including the steam hardening, should not exceed $2 a ton, not including the drying and waterproofing. But it is not necessary to perform these operations at the time the pipes are made, neither need it be done at the same place. Indeed, the pipes may be shipped to any point before waterproofing, if desired, and the drying necessary before impregnating may be done quickly by means of a dryer, or naturally by piling the pipes where they will be exposed to air or sun, or both. The carbonizing process which takes place to a certain extent after the pipes have been removed from the hardening cylinder will in itself add considerably to the water resisting quality of the pipes.

Dilute acids and alkalies have little effect upon sand-lime pipes, and that substance may be safely exposed to the action of seawater, something which cannot be done with terra cotta or other clay products. Repeated freezing and thawing have no effect upon the strength of a sand-lime conduit pipe except slightly to strengthen it, as shown by all of the many tests made by Prof. Woolson. Sand-lime products stand fire better than clay products, provided the lime used was of good quality. In fact, sand-lime, when properly made, possesses the same fire-resisting qualities with which concrete is endowed.

Reinforcing may be applied to sand-lime conduit pipes when necessary, and that substance adheres to steel with the same tenacity that is observed when concrete is applied to that metal. Viewed from the standpoint of an engineer thoroughly acquainted with sand-lime, its properties and its limitations, it seems to be a material well adapted to the making of conduit pipe, and entire junction boxes may be built up of shapes made from the same material and adapted to the peculiar needs of that class of construction. Concrete may be employed to advantage in a similar manner, and one or the other will be found the cheaper accordingly as local conditions and the cost of coal, lime or cement may influence the cost of production. But a word of caution is necessary. A man who rushes into the manufacture of either sand-lime or concrete conduit pipe, or any other forms of those materials, will in all probability make a failure of the whole matter unless he happens upon a bank of material which has been graded by nature to approximate the combination of fine and coarse sand and gravel necessary for making concrete or sand-lime products of the maximum density. Many sand-lime men have failed to make even acceptable bricks through ignorance of the law of material-proportioning for concrete or sand-lime as discussed by the writer in the August issue; but once the law of combination is understood and followed, any man can make either concrete or sand-lime products to the limit of strength possessed by the particular material he has to deal with. By combining with the material at hand the grades of fine or coarse material which are lacking in the given material, the limit of strength and of other desirable qualities may be reached in both concrete and sand-lime conduit pipes, etc.

Willoughby, Ohio. James F. Hobart.

COOLING THE DRINKING-WATER.

An engineer of a certain electric power house, the owners of which would not provide ice for drinking-water, hit upon a method of obtaining a plentiful supply of cold water. A discarded pump cylinder was found on the premises, about 3½ in. x 3½ in. and after a little rigging up and piping, the piston of the cylinder was connected by a reducing lever to a convenient portion of a reciprocating air-pump. A 40-gal. domestic hot water tank was prepared for use as a receiver by having its joints all soldered tight. A coil of rubber garden hose was packed into a wooden box just large enough to surround the water pail and connected with the receiver through a ⅜-in. steam pipe which was so arranged that water at ordinary temperature could be allowed to drip slowly along the pipe when necessary. This cooled the compressed air when the temperature of the engine room went up to 90 and 95 deg. Fahr.

By means of a valve, air was allowed to expand into the coil of rubber garden hose and the effect was soon perceived in an agreeable lowering of the temperature of the water contained in the bucket. Later, the bucket was replaced by an earthern jar, with a spigot attachment through which water could be conveniently drawn as required.

Another engineer who saw the arrangement, rigged a similar air tank and for a supply of air, he procured a common hand bicycle pump, about 2½ in. diameter by 6 in. stroke, and rigged a wooden connecting rod to a pin in a disk on the end of a slow-moving shaft. This arrangement kept the tank air pressure up quite high, the compression of the pump equaling the clearance, and no greater pressure was accumulated in the receiver.

Still another engineer procured one of the little air pumps which work by water pressure, and are automatic in their action, keeping the receiver pressure up to a predetermined point as long as city water or other water under pressure is supplied to the pumping device, which was connected into the receiver—or at least the air discharge was then connected.

This engineer went one better in the cold water business. He was on a principal street of a small city, and he placed the receiver outside the engine room in plain sight and hung out a neat sign which informed 'cyclists that air could be had for tires at 1 cent per tire. A clever home-made valve was rigged up and attached to the tank-pipe—which by the way, led to the cycle supply pipe by way of the engine room, and not direct—by means of which air would be turned on upon application of a cent through a slot for that purpose. The valve automatically closed again when the pressure in the tire equaled that in the receiver. It also closed arbitrarily through the action of a little dash pot, after having been open for a certain length of time.

The engineer took from the tank all the air required for cooling water for drinking purposes, and he also derived some revenue from the sale of air at a cent a wheel, or 2 cents per bike. Connections were also arranged in the engine room by means of which compressed air was used for driving dust and dirt out of the interior of electrical machinery, and for similar cleaning purposes.

Scranton, Pa. John Scott.

QUESTIONS AND ANSWERS

Is it good practice to use compressed air for blowing dust out of motors used in grain elevators? Would there be much danger of causing a burn-out from the moisture caused by the expanding air? Would a vacuum cleaner be safer for this purpose? C. J. W.

It is common practice to use compressed air to blow out the dust from motors of all descriptions. A vacuum cleaner would not be as suitable for this purpose since with it it would be impossible to get at all of the interior parts of the motor. If the pipe lines be well drained and the compressed air permitted to blow freely for a few minutes before it is used on the motors, all trouble due to moisture will be avoided.

How can high-tension underground systems be best grounded? C. N. W.

It is probable that with few exceptions underground high-tension cables are not grounded. High-tension cables in Chicago are grounded in the station by means of numerous copper plates buried in moist earth. The plates are connected to a ground bus to which the lead sheaths of the cables, the steel work of the building and the neutrals of the generators are also connected. A non-inductive resistance of about 2 ohms is connected between the grounding switch of the generator and the bus.

Can the power factor of a three-phase circuit be determined by taking readings from two single-phase watt-hour meters connected in the circuit? E. E.

Take simultaneous readings of the two meters in watt-hours over a certain time, and divide each reading by the time expressed in hours and thus obtain the watts. Each reading may then be considered as having been obtained from a watt-meter. If the larger reading be designated by W' and the smaller reading by W'', then the tangent of the angle of lag is expressed by the following equation:

$$\tan \theta = \sqrt{3}\left(\frac{W' - W''}{W' + W''}\right)$$

from which the angle of lag and its cosine, or the power factor, may be determined. See also letter on the power factor in three-phase circuits in the September, 1907, issue.

Why is a simple lap-wound armature cross-connected in the back of the commutator with only four jumpers instead of every bar? A 10-hp, four-pole machine has jumpers of No. 15 wire and this is only large enough for a 5-hp motor. Do the jumpers parallel the connections so as to increase the carrying capacity? G. V.

The object of the cross-connectors is not as you intimate, to provide a path for the normal working current in the machine, but to eliminate any effect due to inequality in the magnetism from the separate field poles. That is to say, if the two pairs of field poles supply equal amounts of magnetism no current whatsoever will exist in the cross-connectors. If, for any reason the magnetism of one pair of field poles exceeds that of the other, then there would be an e.m.f. between the two brushes which are connected together through a common bus ring. In order to prevent trouble at the commutator and the production of local currents in the brush circuits, several cross-connectors are placed around the commutator. The currents produced locally in these cross-connectors when the terminals are not at the same potential, are in such direction as to tend to assist the weak magnetic field and to oppose the strong magnetic field, so as to render the two fields equal in value.

What are the relative advantages of a single three-phase transformer and three single-phase transformers? H. H.

In general, the three-phase transformer has the electrical advantages of three single-phase transformers. The three-phase transformer, however, is not ordinarily used, in preference to three single-phase transformers because of the financial question involved in carrying a stock of these transformers, especially with smaller companies, and the inflexibility of the transformer compared to three single-phase transformers in emergencies. Where three single-phase transformers are connected in delta for three-phase service and a short-circuit develops on one phase or one transformer is in any way damaged, one transformer may be cut out and the service continued by the other two transformers at slightly reduced output. A three-phase transformer under certain conditions could not be thus operated, and service would have to be discontinued until a new transformer was installed. Accidents of this kind, however, are not as prevalent as heretofore. It is general practice to feed lighting loads from single-phase circuits regardless of whether the generated power is two-phase or three-phase. The commercial advantages of having single-phase transformers available for such service as well as for motor service with a minimum outlay for stock are apparent.

I have an armature core for a 2-hp, 220-volt, four-pole, shunt-wound motor having 33 slots, 33 commutator segments and two brush holders. How many slots should the coils span and how should they be connected to the commutator to obtain a wave winding? P. L. W.

A four-pole armature having 33 core slots and 33 commutator segments when arranged for use with two brushes should be wound as follows: There should be 33 coils; numbering the slots consecutively from 1 to 33, one side of one coil should be placed in slot No. 1 and the return side of the same coil should be placed in slot No. 8. The same method should be followed until all of the coils are in place on the core. It is not absolutely essential for the coil-throw to be exactly from slot 1 to 8. The coils could be placed in slots 1 and 7 or in slots 1 and 9, uniformly throughout, without affecting the performance very materially. Assuming that all the coils are in place, selecting the coil in slots 1 and 9 and designating one lead of this coil as the beginning and the other lead as the end, the beginning lead should be placed in any convenient commutator slot numbered 1 and the end lead should be placed in slot No. 17. It is customary, though not essential, so to number the slots on the commutator that commutator slot No. 6 falls immediately in front of core slot No. 1, making slot No. 8 fall opposite commutator slot No. 13. By this method the two leads of each coil are given equal lengths in reaching the commutator, and neutral points for the brushes are brought to a convenient location around the commutator surface.

Can you furnish me with data from which I can construct two water rheostats, one for each phase of a 750-kw, 2300-volt, two-phase alternator; the rheostats to be used in testing the generator on all loads up to 25 per cent overload for 10-hour runs? I also wish to construct a rheostat for testing a rotary converter rated at 300 kw, 500 volts. Could not one of the above rheostats be used for this purpose? A. D. B.

As ordinarily constructed, a water rheostat is arranged to afford the required resistance for the load on the machine, and the water is allowed to evaporate according to the amount of energy produced. That is to say, it is desirable to supply the rheostat with running water and to allow the water to reach the boiling point at all times. The specific resistance of water varies considerably in different localities on account of the difference in impurities which the water may contain. Assuming that the water in your locality is the same in composition as the water used in New York, a load rheostat for each phase of the two-phase, 2300-volt, 750-kw alternator could be built as a canvas-lined wooden tank 10 ft. long, 2 ft. wide and 3 ft. deep. In the center of each tank should be placed two iron plates electrically connected to form one terminal of the rheostat. At each end of each tank should be placed a similar plate of iron, the two plates being joined together to form the other terminal of the rheostat. The resistance of the rheostat is adjusted by moving the end plates toward or away from the center plates as desired. After the plates have been placed in the proper position, the resistance should remain constant without any further adjustment, on account of the fact that the quantity and quality of water are kept constant by providing a continuous flow through each tank at such a rate that the height is unaltered by the rapid evaporation. Two rheostats of the above-described type can be used as a load upon the above-mentioned alternator and they can be joined in parallel in order to act as load upon the 500-volt, 300-kw generator.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Saw Mill Refuse Versus Electric Power.

At the Michigan convention at Grand Rapids in August, some points were brought out which may be of value to central-station companies attempting to install motors in saw mills and woodworking plants to replace steam plants using wood refuse for fuel. Because of the argument that such wood refuse costs the woodworking plant nothing, it has been difficult for some electric power companies to secure this business. Apparently the value of this refuse has frequently been overlooked by the owner of the woodworking establishment. Mr. William Chandler, of Sault Ste. Marie, said that his company had as a customer a woodworking concern which formerly burned its refuse under its boilers. It now bales these shavings, etc., and sells them, and is operating with electric power, as this is found more profitable than burning the shavings for power. Mr. Crosby, of Detroit, cited the case of a plant which before installing electric power substituted coal under its boilers for refuse, and found that it was more profitable to burn the coal and sell the refuse than to burn the latter, in fact, saving about half the value of the coal. Later the plant took electric service at a still greater saving.

A Record on Fan Introduction.

The Lawrenceville (Ill.) Light & Water Company began to give day service about July 1 last. It now has over 50 fan motors connected. The town has a service population of about 2500. It is believed that there are few towns in Northern latitudes where this record has been equaled as to rapidity of introduction. The situation in Lawrenceville is a good illustration of what can be done by proper co-operation between the contractor and the central station. The selling of fans and other appliances and wiring is done by Mr. A. R. Lewellen, the electrical contractor of the town, supplemented by the efforts of the central-station company. The company being in the midst of reconstructing its plant, and not being in a position to give proper attention to new business solicitation, turned this work over to the contractor, who has gone after business actively. In addition to the notable record on electric fans, the number of electric customers connected has increased 42 per cent since February, 1908, due partially to enterprise in getting after business, and partly to a very much under-developed state of affairs previously. This increase has been made in spite of the competition of 30-cent natural gas.

The Value of Electric Sign Advertising.

Mr. John Vandervliet, of Grand Rapids, called forcible attention to the relative value of electric signs as an advertising medium at the convention of the Michigan Electric Association at Grand Rapids in August. Such advertising, compared with newspaper advertising, is inexpensive, as everyone sees an electric sign when he is in the vicinity of the store and wanting to buy, while newspaper advertisements have to be stored in the mind. The Grand Rapids-Muskegon Power Company rate for electric signs is as follows: Six cents per 2-cp lamp per month to burn until 10 p. m., and 2 cents per lamp per month added for every additional hour. At the 6-cent rate the 16-in. double-face electric sign reading "Drugs," of which a number are used in Grand Rapids, containing 62 2-cp lamps, would cost $3.72 per month, or 12 cents per day. About three years ago there were not more than three electric signs in Grand Rapids. At the present time there are over 120 large signs and a number of smaller ones. The total number of sign lamps will aggregate nearly 20,000, or nearly one lamp to every five people in Grand Rapids. From these 20,000 lamps the central station will realize at least 8 cents per lamp, or $1,600 per month or $19,200 annually. The central station should consider the sign business an important factor as a source of revenue and at the same time the electric company's business is being advertised along with that of the customers'. To boost the sign business the central station should erect an electric sign at its headquarters, and if suitable locations can be found, it would be well to place them in various parts of the city.

Employees as Special Solicitors.

A novel and what has proved to be a very satisfactory method of getting new business for a central station is now in practice at Cadillac, Mich. The Cadillac Water & Light Company some time ago determined to make unusual efforts to add new patrons to its list of consumers and thereby increase the current output. The matter of adopting the best method for getting after this desired business was discussed and the advisability of placing expert solicitors in the field was favored. However, before the matter was settled, Manager Geo. D. Westover decided to try a profit-sharing plan whereby the regular employees might increase their salaries each month.

The scheme as finally put into effect makes every employee a special solicitor for new customers. Each is paid according to the results obtained. The minimum number of lamps provided for in the writing of profit sharing contracts is 10. For each contract for this number of lamps the employee receives an extra one-half day's pay. For a contract calling for 15 or 20 lamps, an extra full day's pay is awarded the employee solicitor. The company gives the men every possible aid in the landing of new customers and provides that if any employee has solicited a person who later gives a contract, as a result of the previous solicitation, the employee making the original call is given the credit of getting the business, and receives his increased pay accordingly.

This plan has, according to the company, not only proved successful because of the increased business obtained, but has as well been of advantage by creating among the employees an individual interest in the company's welfare that could not be otherwise brought about. The employees of the company are of many nationalities, and it has been found that each man is able to get contracts from his countrymen which the company considered impossible.

Tungsten Street Lighting at Hartford, Conn.

Some interesting work with tungsten lamps for street lighting is being done experimentally at Hartford, Conn., by the Hartford Electric Light Company. Mr. R. W. Rollins, the well-known general manager of the company, has furnished us with the following data: "We have installed on Pearl Street in this city several 250-watt tungsten lamps in a vertical position on iron posts, placing the lamps about 9½ ft. above the sidewalk and enclosing the lamps in an opalescent outer globe. On this street, we placed two of these lamps in place of each arc light, thereby distributing the light throughout the street much more uniformly than was accomplished by the arcs. The lighting of the street is very much better than with arc lighting, being much softer and pleasanter.

"We have in operation on our West Hartford circuits, something over 300 60-cp tungsten lamps. To give you an idea of the life of these lamps, I send herewith a test made on 20 of them, some of them burning 4826 hours and some burning 3373 hours. These results are very remarkable, the average candlepower being 58.9. These lamps were not photometered when they were new, hence we do not know what the initial candle

power was. I consider this very valuable data, and giving a good 'line' on the life of the series tungsten lamp."

Subjoined is the record of the test referred to above by Mr. Rollins.

TESTS OF SERIES TUNGSTEN LAMPS TAKEN FROM WEST HARTFORD AND ELMWOOD CIRCUITS.

No.	Cp.	Volts.	Amp.	Watts.	W. P. C.	Discoloration.
12.....	55.5	10.4	6.21	71.0	1.28	"A"
13.....	57.0	10.9	6.23	68.0	1.19	"A"
14.....	60.0	11.0	6.26	69.0	1.15	"A"
15.....	57.5	10.5	6.27	66.0	1.15	"A"
16.....	63.5	10.8	6.24	67.5	1.06	"A"
17.....	65.5	11.0	6.23	68.5	1.04	"A"
18.....	63.0	10.5	6.16	65.0	1.03	"A"
19.....	73.0	10.9	6.24	68.0	.93	"A"
20.....	59.0	10.7	6.21	66.5	1.13	"A"

Installed Oct. 16, 1907. Life of lamps when tested, 3273 hours.

No.	Cp.	Volts.	Amp.	Watts.	W. P. C.	Discoloration.
1.....	52.0	10.1	6.26	64.0	1.23	"A"
2.....	24.2	7.0	6.23	43.5	1.08	"A"
3.....	57.0	10.3	6.29	65.0	1.14	"A"
4.....	59.0	10.7	6.23	66.5	1.13	"A"
5.....	60.0	10.5	6.26	66.0	1.10	"A"
6.....	52.5	10.0	6.24	62.5	1.19	"A"
7.....	66.0	10.4	6.25	65.0	.98	"A"
8.....	72.0	11.6	6.25	72.5	1.00	"A"
9.....	59.0	10.3	6.24	64.0	1.08	"A"
10.....	51.5	10.1	6.26	63.0	1.22	"A"
11.....	61.5	10.9	6.27	68.4	1.11	"A"
12.....	69.0	10.3	6.25	64.5	.93	"A"

Installed Oct. 15, 1907. Life of lamps when tested, 3273 hours.

These lamps were all tested on 6.25 amp (approximately) direct current and were compared for discoloration with the several lamps of varying progressive degrees of blackness lettered "A," "B," "C," etc., to "E," "A" being very slightly blackened and "E" being very badly blackened.

These tests were made on Aug. 21 by Mr. L. A. Keith and checked by Mr. F. W. Prince.

Comparison of Three Notable Street Lighting Systems.

It is interesting to compare three of the most recent prominent examples of the special lighting of town streets, namely, Nicollet Avenue, Minneapolis; Canal Street, Grand Rapids, and Summit Street, in Toledo.

Nicollet Avenue, in Minneapolis, is lighted with tungsten lamps placed on ornamental posts, five 100-watt lamps being used on each post. The posts are 100 ft. apart. For the sake of comparison, the two views of Nicollet Avenue by day (Fig. 1) and by night (Fig. 2) which were printed in our July 18 issue are again reproduced here.

Canal Street, in Grand Rapids, which was described in our issue of Aug. 29, is lighted by arches of 60-cp, 75-watt tungsten lamps. These arches consist simply of bare lamps suspended from a span wire, the span wire being fastened to the buildings. The arches are 100 ft. apart and each has 18 60-cp, 75-watt, 6.6-amp, tungsten lamps in series on 220 volts. Fig. 3,

FIG. 1.—NICOLLET AVENUE, MINNEAPOLIS, BY DAY.

showing Canal Street by night, is reproduced here and also Fig. 4, showing it by day.

Summit Street, Toledo, Fig. 5, is lighted with 4-amp General Electric magnetite arc lamps, each lamp requiring about 322 watts. There are two lamps on each ornamental iron post, as seen in Fig. 6. The posts are placed opposite each other every 80 ft. along each curb.

It is notable that the amount of illumination on these three streets is considerably greater than has been provided by any

FIG. 2.—VIEW DOWN NICOLLET AVENUE, MINNEAPOLIS, BY NIGHT.

special lighting heretofore. In fact, if figured out on a watts-per-square-foot basis, these streets show an expenditure of electrical energy upon them nearly equal to that of some dimly lighted interiors. If all these streets are considered as 100 ft. wide (two of them are more than that width) the watts used

FIG. 3.—CANAL STREET, GRAND RAPIDS, BY NIGHT.

per square foot of street range from 0.1 to 0.16. It is most interesting, however, to compare them on the basis of watts per 100 lin. ft. of street illuminated. On this basis Nicollet Avenue, Minneapolis, takes 1000 watts per 100 ft. of street. Canal Street, Grand Rapids, takes 1350 watts per 100 ft. of

FIG. 4.—CANAL STREET, GRAND RAPIDS, BY DAY.

street and Summit Street, Toledo, takes 1600 watts per 100 ft. of street. Summit Street, Toledo, therefore has the largest expenditure in watts upon it, and, furthermore, since the luminous magnetite arc lamp is more efficient than the tungsten lamp, there is a greater amount of light liberated on the street. Any

one of the three streets is amply illuminated. The general average of illumination is much higher than that prevailing on downtown streets, except at such places where large electric signs and lighted show windows bring the street illumination to a high point.

As to the relative effectiveness and general appearance of these three streets, personal opinions and tastes will probably differ. As to artistic, finished and refined appearance, Nicollet Avenue, Minneapolis, with its ornamental posts, with tungsten lamps in diffusing globes, undoubtedly would be selected as best fulfilling artistic requirements. Canal Street, Grand Rapids,

FIG. 5.—SUMMIT STREET, TOLEDO, BY NIGHT.

with its arches, undoubtedly presents at night the most festive appearance of the three installations. The general impression on the observer is that a roof or canopy has been erected over the street and that it has been studded with incandescent lamps. These lamps are high enough above the street (30 ft. in the middle and 25 ft. at the curb) and of small enough candle-power so that their effect on the eye is not uncomfortable. The span wires with lamps suspended overhead in the daytime do not have the substantial and finished appearance of lamp-posts, but are so small that to the average observer they are not noticeable, as there are many other heavier wires on the street.

Summit Street, Toledo, with its high candle-power arc lamps in clear globes, produces on the observer an effect of brilliance and almost of glare that is not obtained on the other streets. Undoubtedly some would prefer this effect to that obtained on Canal Street, Grand Rapids, or Nicollet Avenue, Minneapolis. It cannot be said that any one of them is best from every standpoint.

As to relative first cost, that of the Nicollet Avenue posts, Minneapolis, is stated to be $145 per post. As there are two

FIG. 6.—SUMMIT STREET, TOLEDO, BY DAY.

posts per 100 ft. of street, the cost would be $290 per 100 ft. The cost of the spans at Grand Rapids, exclusive of the lamps, was $50 each. The lamps are furnished as part of the regular maintenance expense by the central station company. The cost to the merchants is, therefore, $50 per 100 ft. of street. The first cost of the post on Summit Street, in Toledo, has not been given out, as it is included in the general contract for the street lighting of the entire city. Figures which are worth anything on the cost of maintenance are not yet available because of the short time these installations have been in use and the newness of tungsten lamps.

Rates and the Use of Rates.

By H. H. MacPherson.

One of the most revolutionary changes which is now taking place in the gas and electric business is in the matter of the rates charged to consumers. The proposition of sizing up a prospective consumer's conditions of service and selecting the kind of rate best fitted to such conditions is something which requires close study and no little experience. It is a matter of common knowledge that but little attention has been paid to this proposition by gas and electric companies in general. Those companies which have taken up the study of the consumer's conditions of service have found very few cases where good consumers could not be made better ones by changing them to another rate. These same companies have also found that many small, dissatisfied consumers may be changed to large, satisfied ones by a change in rates.

As a general proposition, gas and electric rates must be considered separately, mainly for the simple reason that gas can be easily and cheaply stored while electricity cannot. This means that the fixed charges for the generation and distribution of electricity must be based upon the maximum instantaneous load and not, as with gas, upon an average daily value which can be boosted with ease during the peak.

A commodity the cost of which is mostly made up of fixed charges can be sold with profit by means of flat rates, particularly where the conditions of service can be pre-determined and then controlled within reasonable limits. As a general proposition, flat rates have always been considered as abominations by gas and electric companies, and as things of beauty and a joy forever by the public at large. Like any other good thing, if used indiscriminately they will undoubtedly be applied in many places where they do not fit the conditions at all. The liking of the public for them has led the gas and electric companies to use them somewhat indiscriminately, with such disastrous effects that in many companies they have been dispensed with altogether as impractical. The satisfactory experiences of some companies with them during the recent financial disturbance, however, suggest a close study of this class of rates with a view to determining their possibilities in a more general application to the conditions which they are best fitted to meet.

A flat rate is a fixed sum per month or year which the consumer pays for a fixed service. Wherever the conditions of service can be predetermined accurately and controlled within the limits of the contract, a flat rate will be a great boon to both the company and the consumer. Foremost among the advantages of the flat rate when used under the proper conditions is the mutual satisfaction which it gives both the company and the consumer. The consumer has a perfectly definite contract which defines just what he is to get for his money, and which shows him just how much it will cost. He has no high bill complaints or meter troubles, and he can figure his lighting or power expense as many months ahead as he chooses. The company knows just what it is required to do and it can calculate its income in advance. Last fall, when meter consumers were chopping holes in the income, many a company fell back upon a solid bulwark of flat rate contracts and thus was able to meet expenses.

In the hands of the right kind of a new-business department the results that can be achieved in building up the net revenue and in spreading out the peaks in the load curve by pushing flat rates are nothing short of marvelous. The best evidence of this is the enormous increase in the use of signs and outlines, which is one of the most conspicuous features of our large cities to-day, not to mention such revenue producers as midnight and all-night arcs.

Street lighting is an example of the conditions of service best suited to flat rates. Here we have a large number of lamps burning for a definite length of time and located on circuits which are controlled absolutely from the power house. The contract states the number, kind and candle-power of the

lamps to be used, defines the hours of burning and provides for maintenance and trimming, all for a certain fixed sum per year. In such a case every item of expense is known in advance, and no change can be made without the company's knowledge and consent, because the lamps are entirely under its control.

The chief danger in using flat rates, and the one which has been responsible in the main for the disrepute into which such rates have fallen, is the practice of applying them in cases where the contract limits may be exceeded without the knowledge or consent of the company. The old method of making a flat rate based upon an estimate of the probable consumption as shown by a meter, invited nothing but disaster. In such cases the idea usually was to save the cost of a meter. The cost of the meter was certainly saved—but not to the company.

In the average city no class of load can compare with signs and outlines and interior decorative lighting in smoothing out the load curve and increasing net returns to the company. These classes of business are also usually connected to existing lines and services, thereby making additional revenue for the company without additional construction expense. A load which will accomplish such results as that will certainly repay any amount of study and work that may be spent in securing it.

The first two things that a business man always wants to know about any proposition is what it will cost him and what he will get for the money. The simplicity of the following flat rate contract as compared with other forms, and the simple, direct way in which the consumer is told what he will get and how much it will cost him, should appeal to every live business man:

"The undersigned requests the ——— Gas & Electric Company to make an electric connection at the premises, No. —— ——— Street, for —— 8-cp lamps; and agrees to pay said company $—— per year for service rendered under the following conditions: The above number of lamps to be used for —— lighting. The rate named is for service from dusk until midnight only each night in the year. The company to have the right to turn on and turn off lights at time specified."

In this contract the yearly cost, the number and candle-power of the lamps are clearly specified, and the sign is turned on and turned off by the company's men at the specified time. Any violation of the terms of the contract by the consumer by burning the sign overtime or increasing the candle-power of the lamps used is plain to anyone who may look.

The successes attained in the sign and outline business, due almost entirely to proper pushing of the right kind of flat rates, has led to a great amount of successful study in applying them to other uses. Interior window lighting and interior decorative lighting on flat rates show all the good points of sign and outline lighting, particularly where a meter is set to check the consumption and thus show up any violation by the consumer of the terms of the contract. In places where small lights may be used long hours, but the consumption will not justify setting a separate meter, a flat rate may be made by covering with a fixed sum per month the fixed kilowatt deduction made from the consumption of the house meter. In this way hundreds of residence porch lights, small-rooming house and all-night restaurant signs may be put on the lines at low rates, which would never be connected at the regular short-hour meter rates.

The public's appreciation of this class of flat rates is shown very clearly by the boosting given to flat rate porch lights by a lady who bought an electric iron and did her ironing on the front porch because by doing so she got the current for half price.

As a cure for high bill complaints and dissatisfaction resulting in short hour burning of lights which should burn long hours, a flat rate is the only thing. In hundreds of cases business men who had poor lighting, and besides felt that their bills were too high, have installed additional lighting on a flat rate and thus secured excellent effects and perfect satisfaction.

In places where a flat rate cannot be used and where the consumption is great enough each month to amount on a straight meter rate to about double the fixed charges occasioned by the consumer, it will pay the company to take him on a readiness-to-serve rate. The reason this is true is because the flat-rate part of the readiness-to-serve rate has all the advantages of a straight flat rate, and to those advantages is added the protection of the meter rate. The effect of such a combination rate is to give the consumer a sliding-scale rate, making his current cost him less per unit the more he uses. Since the meter-rate portion of a readiness-to-serve rate is usually less than half the straight meter rate for a given increase in consumption, only about half the increase in the amount of the bill is made by such a rate as is made by a straight rate. For this reason the high bill complaints on a readiness-to-serve rate do not increase perceptibly with the coming of the shorter days in the fall, and the same consumer who used to kick every fall uses more light and is satisfied. However, it must be remembered in applying this rate that the fixed charge is very large, and therefore this rate should not be given in places where the service is not used during some months in the year.

Flat rates on gas are comparatively few, being confined almost entirely to small long-hour consumption, such as coffee urns, glue pots, etc. The fixed charges on gas are much less in proportion than those on electricity; therefore the fixed charge portion of the gas readiness-to-serve rate is small, and the meter-rate portion is only about one-third less than the straight meter rate. The net result is that a much smaller consumer can take the gas readiness-to-serve rate than can take the electric.

In the practical application of such a study as this, cards are taken off the consumers' ledgers showing the consumption, rate, and amount paid, for at least 12 months back, on the account of each consumer who would be benefited by a change in rate. The consumer is then told either by a personal call or by letter that he can save money, and the new rate and the saving it will produce are explained so that he can be signed up on that rate if possible.

Flat rates and sliding scale rates when fitted into the proper places will boost consumption, cut down peaks, thereby improving the load factor, satisfy dissatisfied consumers and, through all this, enormously increase the total business and the net returns.

Charges for Electrical Energy.

By James L. Roberts.

When one considers the charges made for electric energy by a central station he has before him two different propositions. One, which stirs up considerable agitation and thought in central station work may be called, for want of a better term, "Ratings," and the other "Rates." Ratings is not a question of establishing a rate for a community, but is one of satisfying each consumer by charging him a rate per unit of electrical energy proportionate to his equipment and consumption. The other, "Rates," is the question of establishing a stated and permanent charging schedule for a community into which enters production and maintenance costs and fixed charges so as to get a just charging code, fair both to the central station and to the consumer. A very distinct line may be drawn between the two; one is a great unsolved problem, and the other is a matter settled in the great majority of cases by good business tact and ability.

"Ratings," of course, applies to those consumers whose consumption warrants some reduction from the regular schedule. To what extent the practice of making lower rates or of giving discounts should be carried depends wholly upon existing local conditions. Central station managers find that in order to obtain and retain business, it is often necessary to make sweeping reductions, and that there are a great many cases where the consumer's demands are such that it is impossible to attempt, out of fairness to the other consumers and as a financial proposition for the central station, to accede to them.

Everybody wants everything as cheap as it is possible to get it, electrical energy being no exception. A consumer of electrical energy does not know what are the different costs which

go to make up the expense of producing a unit of electrical energy, and furthermore he does not care. He is not interested at all in the matter. All he knows is that he is charged for such and such a quantity of energy at such and such a price. The large consumer looks at the matter in the light of his other buyings. He buys a thousand of a certain article of merchandise for which he pays a stated price. Let him purchase 2000 or more and he gets a discount. This is true of all merchandise, more or less, and in his mind electric energy should be bought in the same way.

There is apt to be one danger in giving low rates to different consumers, and that lies in the cry of unjust discrimination being raised. This would be particularly strong around the time of elections, when political parties for the sake of creating impressions dwell long upon the municipal-ownership and the operation-of-public-utilities questions. The least harm that is done is the placing of a central station in a poor and unfair light in the public eye, which makes it hard for progress to be made in the obtaining of business.

There is one thing about the sale of electric energy for which no other article sold can be given credit, and that is that every central station in the country is alert and on the watch to find methods to reduce the price of production. The price is slowly and surely being decreased. This could never be said of oil, coal, wood and all through the list of other commodities of our life.

When a merchant makes any alterations to cover an increase in his business, installing considerable additional lighting; when a merchant comes from another city and when he wants to make a big electrical display, he demands a lower rate. On the central station's part it is well to ascertain the conditions under which a consumer should be allowed a reduction. A plan which has been adopted by some of the illuminating companies, and about the only real solution of this problem, is to give a reduction on all consumption that occurs on a low peak load providing the consumption is great enough to warrant a reduction, and also where a greater amount per connected lamp is used than would cover the amount an installation's proportion is of the fixed charges.

It is perhaps hard to set forth a specific plan. It will be found that each particular case differs from another in equipment, position on the lines, hours of use and nature of service. There are certain classes of business on which a profit is made, and on the other hand there is the remainder upon which a loss is sustained. Churches, residences and offices as a rule come under the heading of short-hour consumers, with as a rule a large connected equipment. The ideal consumer is the 24-hour one, and the consumer whose consumption per connected lamp approaches nearest to the ideal is the one, if any, who should be given the benefit of any reduction. Whether the equipment is for 50,000 cp or only 25 cp, it matters little so long as the lamps are used for a long period.

It will be interesting at this point to note the case of a large church which illustrates the idea completely. The contract called for a 12 and 8-cent rate without a consumption guarantee and a lamp equipment of 300 16-cp units. The equipment in reality, however, was 800 16-cp lamps and 10 hp in motors. The average monthly consumption was 612 kw-hours, which made the bill $72.96. The consumption per connected lamp per month was 0.68 kw-hour. The church will add another building containing an equal equipment, making a total of 1600 16-cp lamps and 20 hp in motors, expecting to use energy at about the same load factor and a flat rate of 5 cents per kw-hour was demanded. Not obtaining this rate it is the intention to put in a 10-kw oil or a gas producer plant to generate energy at a cost of 2¼ cents per kw-hour, the lighting company offering a flat rate of 8 cents per kw-hour. The company will rest content to wait until the private plant has proved unsatisfactory, and will then welcome the church as a customer.

On the other hand, take a case in the same city where a department store with a connected load of 5136 16-cp lamps. The yearly consumption was 149,489.7 kw-hours, which gave an average monthly consumption of 12,457.5 kw-hours. The consumption of the connected load makes an average of 2.3 kw-hours per lamp per month. The high load factor, together with the fact that the equipment contained many new, striking and novel devices which were a good advertisment for the electric light, obtained for this consumer a rate of 5 cents per kw-hour. The central station made money and gained publicity for its product, as did also the consumer.

A central station that is anxious to increase its earnings will be on the watch to make a proposition to users of energy in which a lower rate on certain service at such a quantity could be obtained. On the assumption that the central station has a charging schedule in force upon which it at least is not losing any money, it is safe to predict that by a rearrangement of the load lower rates can be profitably given. What, then, would have to be considered in the framing up of a proposition of such a nature? There are a great many consumers whose equipment could be used to better advantage elsewhere on the consumer's premises and at the same time so be placed that the load would come before or after the peak. That is, the lamps may be placed where they will do some good to both parties.

The above point is well illustrated by the following instance: The show windows of furniture stores are generally wired for chandeliers or clusters along with trough reflectors. In the store proper there are clusters of arc lamps and in the upper stories, used more or less for storage, there are some more clusters or arc lamps. Outside over the street will be found four or five arc lamps. This manner of wiring, with perhaps a few variations, is in use in many cities. At about 6 p. m. through the week all of the lamps are turned off with the exception of a lamp or two over the safe in the offices. The inside equipment is used only during the day when goods are to be displayed and on Saturday night from dark until 10 or 11 o'clock is the only time that the lamps are used to any extent at all. The outside arc lamps are only used at that time. In this case the connected load is never used except on Saturday night on the high peak, and it is idle all the rest of the time. It would be best for the consumer and for the company to change the equipment so that it could be used more. The writer would suggest the following plan: The outside equipment of arc lamps and the clusters or chandeliers in the show windows should be omitted entirely. In their places there could be erected a sign whose character would depend upon local conditions. If the building is of three or more stories in height and located on a thoroughfare upon which many people pass, the upright double-faced sign could be used to great advantage with a flasher. It would be advisable where such an equipment is installed to use a permanently lighted top so as to present some idea before the public all the time and not have the sign in darkness while the flasher is changing over. After a certain hour, say 11 or 12 o'clock at night, the flasher could be stopped and the top piece left in service.

The trough reflectors in the show windows should be so wired that for late and all-night service only one-half or less of the entire equipment need be used. Instead of having a row of say from four to six clusters in the store proper, it would be better to allot a space for the ordinary kitchen arrangement, a parlor scene, a bed room, a dining room, library, a staircase, and so on, through the remainder of house furnishing sets. These could be permanently arranged and an artistic and suitable fixture could be placed in the center where it would properly illuminate the arrangement. Clusters with frosted globes are suitable for this purpose. On the upper floors single drop lamps could be employed to just as good advantage is for 50,000 cp or only 25 cp, it matters little so long as the lamps are used for a long period.

Having reduced somewhat the entire equipment and placed the rest where it can be used, the proposition for a lower rate can be entertained providing the installation is employed as outlined, because there would be considerable increase in the consumption per connected lamp. The exact facts of an installation undergoing such a change are that the old installation was composed of 381 16-cp equivalents made up of arc lamps,

clusters and incandescent lamps and under the new arrangement the equipment amounted to 200 16-cp equivalents—a saving of 181 16-cp equivalents. The average monthly consumption of the old installation was 298.4 kw-hours or 0.78 kw-hour per lamp per month. The average monthly consumption of the rearranged equipment of 200 lamps was 376.9 kw-hours, giving 1.88 kw-hours per lamp per month, thus developing greater consumption per connected lamp. In the case cited a lower rate was granted on all energy consumed above 100 kw-hours per month.

INTERIOR WIRING AND ILLUMINATION

The Contractor and the Central Station.

By Samuel J. Robinson.

The policy of the different central stations throughout the country toward the electrical contractor is broadening every day. There have been a few central-station companies who realized from the very first the value of the results obtained by offering every encouragement to the contractors. However, there have been other companies who have always done, and are still doing, absolutely nothing toward co-operating with the contractors. Some have even placed restrictions upon the work and business of the contractors. For example, a certain large illuminating corporation operating in a score of cities, for some reason or other, fought the contractors in every way. This company was at that time doing wiring and selling the various appliances, motors and fans in direct competition with the contractors and at figures so low that it was not possible for the contractors to make sales or obtain any work. This action brought about a consolidation of the contracting interests, and finally after considerable public feeling had been aroused and quite a loss had been sustained by the lighting company, it gave up the work of wiring, but still sold the fans and motors at prices that the contractors could not equal. Later a stated price was agreed upon by the company and the contractors for the sale of motors and fans, which allowed some profit. While perhaps the company gained some business through doing the wiring, yet it is possible that the increase would have been greater had all the contractors been working under favorable conditions.

Without a doubt the electrical contractor is an important and valuable adjunct to the central station in its search for new business. He is a part of the new-business department, and in many lighting fields he is the whole department and the only force actively pushing the sale of energy. It doesn't take much business judgment to understand that in a city where there may be perhaps 10 contracting firms actively engaged in business it would be good policy for the lighting company to give them every encouragement and attention. It is a case of 10 distinct forces working toward one end, that of the increase of energy consumption. It has been found that in towns that are too small to support a local contractor, the company has been forced to do all the construction work, and efforts have been made in some of these towns to induce a firm from a larger nearby city to open a branch office or shop and take care of such work for the company.

It will be found that of the companies that are doing wiring to-day the greater number will state as a reason for their doing so is that there is no reliable contractor in the field. This is true of a great many of the middle-sized cities in the East. There are any number of cities with populations ranging from 20,000 to 100,000 that have no one to take care properly of wiring jobs outside of bell hanging. For instance, in a certain city with a population of 284,000 inhabitants there is not a contractor who can handle a large contract. In this particular city the company does no wiring of any character, yet this same company shows on its new-business report an average monthly gain of 2000 16-cp equivalents, including the motor load. The work is done by outside firms who have pushed their way in by the aid of their own solicitors.

On the other hand, there is the smaller-sized city, full of business life that supports perhaps three contractors at the most, who can take care of every contract that is presented in the city. The show rooms and windows of these contractors are, as a rule, kept in better style than the majority of the show places to be found in a great many central stations. Not only will the central station and the contractors in these cities have attractive business premises, but the remainder of the business houses will be found to be of the same character.

Various schemes have been tried to help the contractors along and also to urge them to greater activity by several central stations. Some of the larger companies that issue monthly bulletins make it a point to give a list of reliable contractors so that any consumer or prospective customer has before him at once the entire number of contractors that will be glad to figure on the work. In one city in New England the central station makes it a point frequently to call attention on a specially written advertising pamphlet and also in the daily newspapers to the fact that a certain firm in the city, with which the company has no connections whatsoever, will construct and wire electric signs of all styles in a thorough manner. It also advertises the other smaller contractors and is prepared to guarantee the work done by them. The company has found that this scheme has placed the contractors upon a secure and substantial footing with their consumers and the general public. It acts as a strong endorsement that has become to be accepted without question by the people.

A year ago in a large Eastern city there arose considerable feeling between the contractors and the company over the fact that the company was not dealing fairly with the contractors. The main bone of contention was the sale of fans and motors at a price lower than cost by the company. This fact was made conspicuous throughout the territory by the company advertising the extremely low prices in the newspapers and with special literature. It also made large window displays of the fans. Right next door and along the main streets were the contractors with their windows full of the same make fans, advertised to sell at a greater rate than the company asked. One of the largest contracting firms engaged an expert solicitor to make an active and a hard campaign among the larger consumers for the installation of private plants with the result that it installed four and had prospects of placing six more isolated plants, when the affair was called off and everything was adjusted satisfactorily.

One large central station manager, in speaking of the contractor, said that his company has recognized the advisability of increasing the new business work through the contractors. His company had maintained a large new-business department employing quite a number of solicitors, but found that the solicitors "played favorites" with the contractors more or less, so that the contractor who had the majority of the solicitors on his staff got the cream of all the construction work. It also found that the wiring contractors depended almost entirely upon what the lighting company's solicitors brought them and did no canvassing for business themselves. This action caused the company to pay men to get business for itself and at the same time for the contractors, without the help of the latter. The company thought that it could improve the condition in that without reducing its new business force it would have the contractors more on the outlook for prospective customers, or in other words would utilize them as an auxiliary new-business department. Therefore, advertising matter was printed for each contractor to distribute. The newspapers were also used, and each week there appeared a column containing special items under each contractor's name. The company paid one-half of the advertising expense. The contractors then received a stated sum for each new consumer brought in by their efforts. All new work that was brought in by the lighting solicitors was immediately sent around to each of the contractors capable of handling it, so that all could bid on the

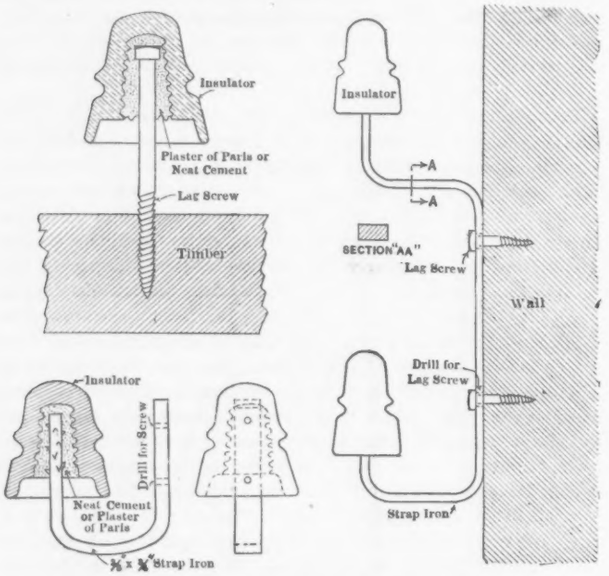
work. This arrangement did away with all contention about favorites being played. After some time the company stopped paying its share of the advertising, but to a certain extent the advertising was continued by the contractors. The newspaper cuts were reduced to merely a business card insertion. The paying for new consumers was also stopped. But the idea took root and has shown good results.

Another central station offers to the contractors a big reduction on all energy used in their show rooms and shops by granting a three-cent rate per kw-hour, the regular rate being 13 cents. It also furnishes the contractors with anything in the electrical appliance line that could be used to advantage in their show rooms and windows.

Home-Made Insulator Fixtures.

By George R. Voit.

It is not a difficult matter for the electrician to make for himself insulator fixtures for the support of electric conductors, although, as with other home-made appliances, it may be found to be cheaper to purchase them from a regular manufacturer of such material. Where only a few fixtures are required, and required quickly, the method described herein, if followed, will result in a thoroughly dependable article. Fig. 1 shows clearly



FIGS. 1, 2 AND 3.—INSULATOR AND WALL BRACKETS.

the method of cementing a wrought-iron stem in an insulator. The stem might be a lag screw as indicated in Fig. 1, a wrought-iron bolt as shown in Fig. 4, or, as indicated in Fig. 2, a piece of bar iron. To make such a fixture, the insulator is inverted and the stem supported in a proper position in it. Neat cement, mortar or plaster of paris is then poured into the threaded cavity. Rough and ready devices for supporting the stem while the cement is being poured into the cavity and while it is setting will be described later.

Whether to use cement or plaster of paris will depend upon the conditions of service to which the insulator will be put. Cement when fully hardened is much stronger than plaster of paris; but from 30 minutes to an hour is required for the mortar to take its initial set, and months may pass before it attains its maximum hardness. Cement has set when it resists the pressure of the finger nail. For permanent, out-of-door intallations cement is preferable. To obtain the greatest strength and quick setting, only enough water should be added to the dry cement to dampen it thoroughly. This putty-like mixture is tamped well with a 10-in. length of ¼-in. round iron rod or other convenient object, into the cavity of the inverted insulator around the iron stem. When the initial set has taken place, the fixture may be gently removed from the supporting rig. Too much water should not be used in mixing the cement, as the time to harden will be considerably increased while the strength of the cement will be decreased.

Plaster of paris has the advantage of setting very quickly, and, although comparatively weak, it serves well where the conditions are not too severe. Certain wall plasters prepared for the building trades are harder than the ordinary sort, and where available will be found to answer well. In mixing plaster of paris, water should be added until the mixture has

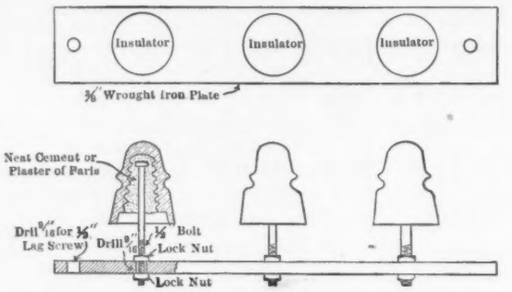


FIG. 4.—RUGGED THREE-INSULATOR FIXTURE.

the consistency of thick cream. The plaster should be stirred briskly and thoroughly, to remove all lumps, and quickly poured around the stem into the insulator's cavity.

As to the insulators themselves, glass ones are by far the cheapest and give satisfaction where they are not subject to excessive mechanical strains. The thousands of them in use bear testimony to their adaptability. If, however, heavy conductors are to be carried, a less brittle substance than glass should be chosen. Porcelain has some good qualities in that it is stronger than glass and less hygroscopic, but it is costly and is seldom used except on high-tension lines. Composition insulators known by such names as molded mica or micanite are tough and durable, and, although they cost several times as much as glass, are widely used for supporting large wires. Many street railways have adopted this type for carrying feeders, and they are used extensively in industrial plants on heavy leads. The composition form is particularly adaptable where the insulator is supported on a metallic pin on a non-yielding structure, such as the steel roof-truss of a building or a wrought-iron pole. In such locations as these, glass or porcelain is more prone to crack than if on more flexible wooden members. The above observations relating to insulators are made with the assumption that the voltage of the circuits to be handled does not exceed 500. For higher voltages either glass or porcelain insulators should be used. No particular material is indicated for any of the insulators shown in the

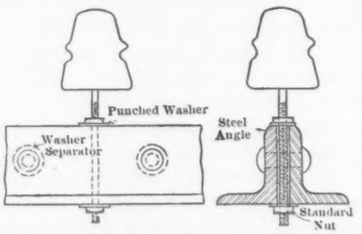


FIG. 5.—INSULATOR SECURED TO TRUSS MEMBER.

drawings, as the one used must be determined by local conditions.

Figs. 1 to 7 illustrate a few of the many sorts of insulating fixtures that may be made, according to the method under description. Fig. 1 shows the simplest. It consists of a lag screw, imbedded in a binding mortar, in the cavity of an insulator of the petticoat type. It is used for sustaining a wire where it crosses a timber, such as the bottom chord stick of a wooden framed building. When installing, a hole should be bored in the timber slightly smaller than the diameter of the

lag screw. A spare lag screw should be turned into the hole to form a thread and then removed. Finally, the lag screw carrying the insulator is turned into the now threaded hole with a pipe or alligator wrench.

A wall bracket is shown in Fig. 2. It is held to its supporting surface with screws which pass through holes drilled in

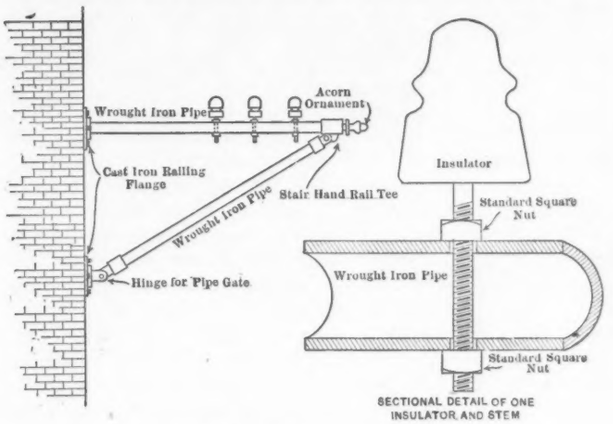


FIG. 6.—WROUGHT-IRON PIPE BRACKET.

the strap iron, U-shaped piece. Before the end of the strap iron, that carries the insulator, is inserted it should be roughened to insure its holding firmly in the cement. Roughening may be accomplished either by pounding with the pene end of a hammer, or, better, by gouging small slits with a diamond-

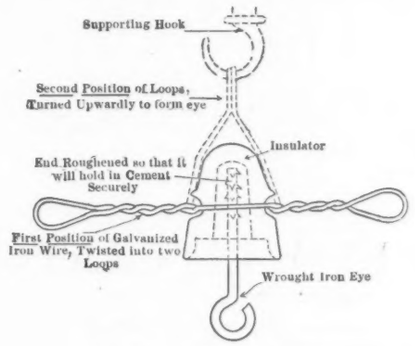

Supporting Hook
Second Position of Loops, Turned Upwardly to form eye
Insulator
End Roughened so that it will hold in Cement Securely
First Position of Galvanized Iron Wire, Twisted into two Loops
Wrought Iron Eye

FIG. 7.—ARC LAMP HANGER.

pointed chisel in the surface of the metal, which causes V-shaped fins to project. The drawing (Fig. 2) shows the strap iron roughened by treatment with a chisel. The form shown in Fig. 3 is an elaboration on that indicated in Fig. 2. It is tion of one of the components of the type shown in Fig. 4. This form (Fig. 5) is useful when electric conductors are to be carried about steel framed buildings. Frequently the steel members forming roof trusses or struts are separated by gusset plates or washers from ⅜ in. to 1 in., and in such cases it is feasible to insert between the members thus separated bolts carrying insulators in the manner shown. A punched washer should be placed on the bolt between each of the nuts and the steel members, otherwise difficulty will be experienced when adjusting the nuts, due to their corners catching in the slot between the steel pieces. The head of the bolt in Fig. 5 is held by the insulator as indicated in Fig. 4.

Wrought-iron pipe and commercial pipe fittings can be assembled into useful forms of brackets and fixtures. Fig. 6 shows such a fixture. All of the components of the bracket therein shown may be purchased from any large dealer of steam fitters' supplies. Such fittings are usually obtainable to accommodate ½-in., ¾-in., 1-in., 1¼-in., 1½-in. and 2-in. pipe. Which size of pipe to use for any particular device must be decided by the duty that it is to perform. Pipe of 1-in. and 1¼-in. nominal inside diameter is used generally for railings, so that there is a probability of obtaining fittings for those sizes more readily than for others. The sectional detail at the right-hand side of Fig. 6 indicates clearly how an insulator may be attached to a wrought-iron pipe contrivance. Structures built from wrought-iron pipe for carrying electric conductors are easily made from available materials, are rugged and sightly, and are finding a wide application, particularly about industrial plants.

It is frequently desirable to suspend arc lamps from a hanger which will insulate the casing of the lamp from the suspending chain. A home-made contrivance to fulfill this function is illustrated in Fig. 7. A loop of galvanized iron or brass wire is twisted about the groove of an insulator so as to form two eyes. These are then bent upward and brought together so that they may hang over a hook. A wrought-iron eye with a stem cemented into the insulator's cavity is all that is necessary to complete the hanger. This same arrangement may be used for a strain insulator. Solder applied to the turns of wire adjacent to the insulator will prevent its untwisting. It is always advisable to test the strength of such a home-made insulating hanger before subjecting it to actual service, where a failure might result disastrously. Such a test may be made by supporting the hanger on a stationary hook and applying to the wrought-iron eye a weight two or three times as heavy as it will ever be called upon to sustain in service. Eyes formed from iron rod ¼ in. or ⅜ in. in diameter will probably be sufficiently strong to bear safely any tension likely to be brought upon it. The wrought-iron eye is cemented into the insulator in the manner previously described. The weak point in this construction is apt to be the bond between the roughened end

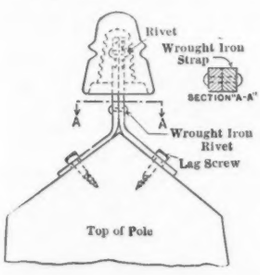


FIG. 8.—POLE TOP FIXTURE.

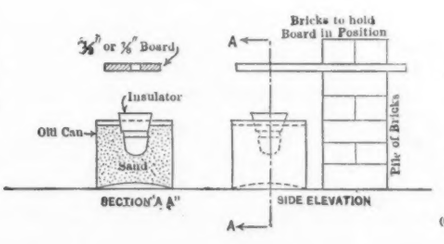


FIG. 9.—INSULATOR AND BOLT HOLDING DEVICE.

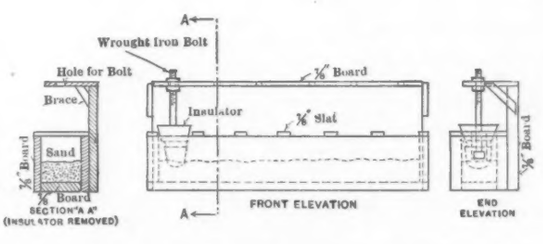


FIG. 10.—ARRANGEMENT FOR SECURING INSULATORS AND BOLTS IN POSITION.

constructed in the same manner, but there is twice as much of it. Its application is obvious from the illustration.

Three conductors may be carried on the fixture delineated in Fig. 4. A piece of ⅜-in. wrought-iron plate forms the base of the fixture. The insulators are carried on wrought-iron bolts, which are secured to the base plate by jam nuts. The assembled device may be bolted or secured with lag screws to the member that supports it. Fig. 5 illustrates a modifica- of the wrought-iron eye and the cement. It is not wise to use plaster of paris in the construction of the type of fixture shown in Fig. 7.

A single insulator, pole top fixture such as that shown in Fig. 8 is robust and easily made. The Y-shaped support is built up from two pieces of bent wrought-iron bar, which are riveted together at two points. It is secured to the pole top with two lag screws. This type is sometimes attached to the

ridge of a roof, or if the bend in the pieces of wrought-iron be of 90 deg., it can be bolted to any horizontal surface.

Some means must be provided for maintaining the insulator and bolt in their proper relation while the binding mortar is being poured into the hole in the insulator, around the bolt. A rough-and-ready jig for this purpose is shown in Fig. 9. Sand in a tin-plate can is packed about the inverted insulator to retain it and the bolt is supported through a hole in a board, which is held where it belongs by a pile of bricks. Fig. 10 shows a bolt held in alignment, in a somewhat similar contrivance, all ready for the pouring of the binding mortar. Although the arrangement shown in Fig. 9 is sufficiently elaborate if only a few insulators and bolts are to be assembled, the brick pile occasionally topples over and there is a chance of the tin can shifting. It will be found profitable to construct the more pretentious rack, detailed in Fig. 10, if there are many fixtures to be made. This rack is constructed of rough boards, and the tray contains sand in which the tops of the inverted insulators rest. Slats nailed across the top of the tray prevent any movement of the petticoat end of the insulator. The bolts are confined in holes bored in a horizontal plank. Two nuts on the bolt, one set up snugly on each side of the plank, retain it rigidly. The rack shown has a capacity of five insulators. Obviously the contrivance may be changed so as to accommodate a greater or less number. Insulators and stems of the types shown in Figs. 1, 4, 5, and 6 are assembled in this sort of rack. For assembling those shown in Figs. 2, 3, 7, and 8, somewhat different holders will be required, which can be easily constructed by modifying the above suggestions.

Letter to the Editors.

The Flaming Arc and the Tungsten.

To the Editors of Electrical World:

Sirs:—In connection with the increasing use of the high-efficiency arc and incandescent lamps concerning which so much excellent material was published in the first issue of September, it is surprising to note the influence the flaming-arc lamp has in compelling the use of the tungsten lamp for interior illumination, especially in stores. It is customary for such tradesmen as appreciate the value of the flaming arc as an advertising medium to install one or two of these lamps in front of their stores.

The excessive brilliancy of the light causes the pupil of the eye of the observer to contract to such an extent that the interior illumination of the store appears defective, although in reality it may be excellent so far as distribution of light and intensity of illumination are concerned. The contrast is so great that the storekeeper is compelled to use tungsten lamps in place of the ordinary incandescent lamps, and to use more of them. This phase of the situation has probably not occurred to those modern Jeremiahs who cry woe to every improvement which presages a diminution of energy consumption per outlet connected to their systems. I have in mind a business street in one of the poorer sections of New York City, where there are not less than 12 flaming-arc lamps on a single block. The stores are open every night until 10 o'clock, and the block is brilliantly illuminated until that hour. In each case the flaming arc is used for advertising purposes, and to offset the shadows in the windows, the roofs of the latter are studded with 60-watt tungsten lamps in mirror reflectors. The interior of the stores are also lighted to the same degree of brilliance to counteract the impression of dimness.

The energy consumption per outlet in these installations has increased instead of diminished, and the brilliancy of the street lighting has attracted business to the block. Other stores not so well lighted have suffered by the contrast, since if there is one thing above all others that brings business it is the appearance of prosperity. The dazzling light of both the flaming arc and the tungsten lamp not only causes the light from the ordinary carbon-filament lamp to appear dim, but also shows up the sickly green light from the gas lamps, and leads subsequently to their removal.

New York. Henry E. Rican.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

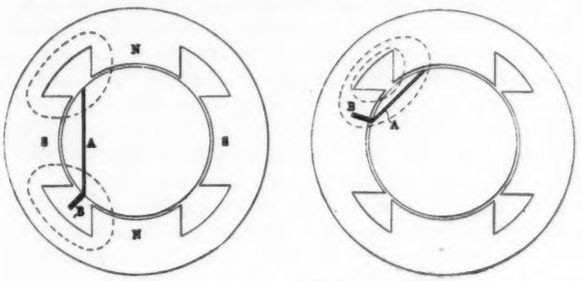
Production of Heat in Electric Machines.—R. Goldschmidt.—The first part of a paper read before the German Asso. of Elec. Eng. on the fundamental laws of the production of heat in electric machines. The author first gives figures for the heat conductivity of different materials. This is generally given as the quantity of heat in gram-calories which pass per second through 1 cm cube between two opposite surfaces, if the temperature difference between these two surfaces is 1 deg. C. For electric calculations it is easier to define the heat conductivity as the number of watts equivalent to the heat per second passing between two opposite surfaces of a centimeter cube at 1 deg. C. temperature difference. The figures C in the following table give the heat conductivity as thus defined. The reciprocal K is the temperature difference in degrees C. which is required between the two opposite surfaces of the centimeter cube in order to drive 1 watt of heat from one surface to the other. The following figures of C and K give average values:

	C in watts.	K = 4400°
Air	0.0002	
Cotton	0.0004	2500
Paper	0.0012	830
Presspahn	0.0018	550
Cable insulation (impregnated jute and paper)	0.0011	900
Gutta-percha	0.002	500
Concrete	0.0009	1100
Oil	0.0016	625
Wood (along fiber)	0.0013	770
Wood (across fiber)	0.0004	2500
Water	0.006	165
Iron	0.65	1.5
Copper	3.8	0.25
Brass	1	1
Zinc	1.2	0.85
Tin	0.65	1.5

The author then discusses the loss of heat by radiation. The loss depends on the temperature difference between the machine surface and the surrounding air and on the condition of the surface. For black or dark and rough surfaces the Stefan-Boltzmann law leads to the following approximate relation: Watts radiated per square centimeter per degree of temperature difference $= 0.0001\ (3.5 + \frac{a}{20} + \frac{b}{33})$, where a is the temperature of the air and b the excess temperature. For an air temperature of 20 deg. C. the watts per square centimeter per degree C. excess temperature are $0.0001\ (4.5 + \frac{b}{33})$. For $b = 40$ deg. C., the watts are 0.00057. For polished and slightly oxidized copper (as used in commutators), the radiation is only about 10 per cent of the value of the above formula. In this case the radiation is almost insignificant in comparison with the loss of heat by conduction by circulated air. The author then discusses at some length the loss of heat by air conduction. He shows that it is impossible to give exact formulas, but gives some which are approximately correct. The paper is to be continued. —*Elek. Zeit.*, Sept. 10.

Variable-speed Single-phase Motor.—An illustrated description of a new modification of the repulsion motor due to H. C. E. Jacoby. When an ordinary direct-current winding connected to a commutator is employed in alternating-current work, the coil undergoing commutation is in such a position that it encloses the whole magnetic flux, as is shown in Fig. 1. This flux being alternating produces a considerable e.m.f. in the short-circuited

coil. This e.m.f. is out of time-phase with the main rotor current, and causes large surging currents to exist in the coil. On the other hand, in the new motor, the rotor is so arranged that the coil short-circuited by the brush encloses little or no magnetic flux; that is, is parallel to the transformer flux, with the consequence that commutation is brought under conditions similar to those existing in direct-current motors, and can be provided for with, it is claimed, equally good results. This is accomplished without any complicated connections. The rotor coils are wound across fractional pitch—much less than anything previously employed—and the brushes are placed in a position so that the short-circuited coil lies parallel to the trans-



FIGS. 1 AND 2.—FLUX DIAGRAMS.

former flux, as shown in Fig. 2. It is claimed that the resultant torque is at least as good as with the ordinary winding; further, that with the new winding equally good commutation is obtained with any brush position between that of maximum and minimum torque; this feature makes it possible to govern the speed of the motor by shifting the brush position. When a shunt characteristic is desired use is made of a simple centrifugal governor arranged to vary the position of the brushes to suit the load. The fact that the friction of the brushes causes the brush-rocker to tend to revolve in the direction of rotation greatly facilitates this control. As the brush-rocker and brushes would revolve were they not prevented from doing so by the governor, it is only necessary that the latter should exert a force equal to the friction of the brushes, and the slightest deviation from this amount will cause the brushes to advance or recede. The speed can easily be governed by this means within 5 per cent of the normal. When an adjustable-speed motor is required for direct gearing to a machine—such as a printing press—excellent results are said to be obtained by simply attaching a cord to the brush-rocker, by means of which the speed can be varied from a very low value to full speed. If an adjustable-speed motor with a shunt characteristic is desired, the motor is assembled with a governor and the speed is varied by adjusting the tension of the governor spring. This spring is in an accessible position, so that a distance control can be arranged by levers or by means of an auxiliary motor. The motor seems to be especially suited for driving machine tools, etc. Tests on a 5-hp motor at 900 r.p.m. on a single-phase circuit of 200 volts and 50 cycles, showed the machine to have a full-load efficiency of 85 per cent, and a half-load efficiency of 77 per cent, a power factor of 0.85. A starting torque of 1 lb. at 1 ft. radius per 100 volt-amp was developed between normal starting torque and 2½ times full-load torque. It is also stated that the speed range is practically unlimited, and that a motor may be switched directly into circuit without a controller or starter of any kind.—Lond. *Elec. Eng'ing,* Sept. 10.

Switch and Transformer Oil.—An article in which it is pointed out that good switch and transformer oil should comply with the following specifications: It must be pure mineral oil, obtained by fractional distillation from heavy petroleum product, and not subjected to any chemical treatment whatever. It should be absolutely free from moisture, alkali, acid or sulphur compounds. The flash point, as determined by an approved type of "closed test" apparatus (Pensky-Marten or Gray's apparatus) should be not less than 175 deg. C. (347 deg. Fahr.), while the burning point should be at least 200 deg. C. (392 deg. Fahr.). The dielectric strength, as measured by the voltage required to arc across two pointed electrodes 4 mm apart, submerged to a depth of from 6 cm to 8 cm, should have a minimum value of 30,000 volts. The specific viscosity, as determined by the Engler or other viscometer, should not exceed 15 at a temperature of 20 deg. C., water being taken as the standard. Further, the oil should still be sufficiently liquid at 0 deg. C. to form drops readily. The specific weight at a temperature of 15 deg. C. should have a minimum value of 0.87 and a maximum value of 0.92. When heated to 100 deg. C. under standard conditions as regards shape and capacity of vessel used, etc., for eight hours, the loss by evaporation should not exceed 3 per cent. Chemical treatment of any kind must be strictly excluded, as the slightest trace of acid or alkali will sooner or later seriously attack the windings, electrolytic action hastening the process. For these reasons, a dark-colored oil should not be objected to, as light oils may owe their color to chemical treatment. All oils appear to darken gradually with use, but this change of color does not seriously affect their properties as insulators, the change being due to heating. Sulphur compounds have a very bad effect, a small percentage lowering the dielectric strength to quite an alarming extent, in addition to which sulphur readily attacks copper, so that all traces of sulphur must be removed. The flash point must be high. Quite a small percentage (approximately 0.5) of light oil, such as benzine, will lower the flash point by something like 100 deg. C. Ball-and-ball electrodes about 20 mm in diameter appear to be the most satisfactory, if kept accurately in line—that is, not askew. It is a curious fact that after the first one or two discharges the dielectric strength of the oil increases. This may perhaps be due to the arc having a drying effect on the oil or possibly to the impurities being burned out. Viscosity does not affect the insulation resistance, many of the lighter oils, such as kerosene and turpentine, having as high or even a higher insulation resistance than the heavy oils. Hence, for transformer work, considerable variation in the viscosity is permissible, although a very great increase in viscosity should not be allowed, since the rapid circulation, and hence the cooling, of the oil will be affected thereby. On the other hand, in the case of switch oil, viscosity is of importance, as a light oil is more easily displaced by the arc than a heavy one. Specific gravity is not proportional to viscosity, although, as a rule, an oil that has a high specific gravity will also have a high viscosity. Volatility is readily determined by heating, say, 5 grams in a large porcelain basin to a temperature of 100 deg. C. for eight hours, and finding the loss in weight, from which the percentage loss is readily determined. The affinity for oxygen, which is marked in the case of vegetable, resin and animal oils, producing sticky, gummy deposits and developing fatty acids, is almost entirely absent in the better grades of mineral oils. Hence, there is absolutely no danger of spontaneous combustion with mineral insulating oil.—Lond. *Elec. Rev.,* Sept. 11.

Enclosed Motors.—L. ISAMBERD.—The capacity of an enclosed motor is limited by the heat produced in it. The author considers the different losses which produce heat in the motor and shows how to design to obtain maximum power. For a given constant total loss, the losses are considered as a function of the flux and the output rating of the motor is calculated as a function of the flux. It is shown that it has a maximum for a certain value of the flux. For this value the copper losses are always less than the iron losses. Moreover, the maximum power of an enclosed motor increases very little with the speed. Finally, the author shows that, by starting from the data for an open motor, it is possible to find the ratio of the output rating of this motor to that of an enclosed motor of analogous construction.—*La Lumière Elec.,* Sept. 5.

Rotary Converters.—E. J. BERG.—A continuation of his mathematical series on rotary converters. In the present installment the author discusses the power factor.—*Gen. Elec. Rev.,* September.

Lamps and Illumination.

Distribution of Light from a Linear Incandescent Body.—K. NORDEN.—The fundamental law of photometry that the candle-power decreases with the square of the distance, is correct only for a point source of light. It does not hold true for extended linear sources of light, for instance, for mercury-vapor lamps. The author formerly calculated the distribution

of light in a plane perpendicular to a mercury-vapor tube. He now gives exact formulas for the distribution of light in a plane parallel to the vapor tube. The formulas are applied to practical examples and a calculation is made of the error committed when the candle-power of the lamp is assumed to be concentrated at a central point.—*Elek. Zeit.*, Sept. 10.

Generation, Transmission and Distribution.

Peat.—H. R. Sankey.—In a paper read before the Brit. Assoc. for the Advancement of Science, the author refers to a bill in the British Parliament to utilize peat deposits in Ireland. It is proposed to produce gas from peat, to use this gas for generating electricity by means of gas engines and generators, and to distribute electric energy to works which will probably be established in the immediate neighborhood of the station and throughout a certain prescribed district. It is proposed to place the generating station alongside the Grand Canal, not far from Robertstown, about 25 miles from Dublin. Sulphate of ammonia is the principal by-product. The amount obtained depends on the percentage of nitrogen in the peat. The proposed station at Robertstown will be capable of making 3000 tons of sulphate per year. The other important by-products are acetate of lime, methyl alcohol and tar containing paraffin wax and oils. An excellent wagon grease can be made from the tar, the output of which at Robertstown ought to be about 2000 bbl. per year. The monetary value of these by-products will be about equal to that of the sulphate of ammonia.—Lond. *Elec. Eng'ing*, Sept. 10.

Steam Turbines.—C. Stoney.—A paper read before the Brit. Assoc. for Advancement of Science on recent developments in steam turbines and turbo-generators. He has found that a compensating winding gives better commutation in direct-current generators than do either auxiliary poles or commutating poles and compensating winding combined. This winding is generally concentrated on the pole-pieces, and, he said, is given from 2 to 2.5 times the ampere-turns of the armature. In the case of alternators, the staying of the end windings had received much attention during late years, to prevent breakdowns in the event of short-circuits. For the design of the rotor he prefers salient poles to the barrel type. Referring to the importance of a high vacuum, it is stated that 1 in. of vacuum is equivalent to 5 per cent of the steam consumption.—Lond. *Elec. Eng'ing*, Sept. 10; Lond. *Electrician* and *Elec. Rev.*, Sept. 11.

Traction.

London.—Comparative tables giving a complete analysis of the published accounts for the past half-year of the six electric tube railways operating in London. The ratio of total working expenses to gross receipts was 48.03, 50.1, 50.75, 51.83, 54.42 and 63.56 in the six cases. The cost of generating the energy per train-mile was 9.632, 17.61, 11.64, 12.61, 12.47 and 11.8 cents, respectively; in considering the last six figures, the first three must be compared together, as they refer to companies having their own generating stations, whereas in the last three cases energy was purchased from a supply company.—Lond. *Elec. Rev.*, Sept. 11.

Car Weights and Seating Capacity.—A diagram giving data on the variation of the relation between car weights and seating capacity for 46 different cars of modern design in use on a number of roads, mostly for interurban service.—*Elec. Railway Jour.*, Sept. 19.

Installations, Systems and Appliances.

Greenfield.—I. M. Cushing.—An illustrated article of the Greenfield Electric Light & Power Company, at Greenfield, Mass. The station now contains two 400-kw, 2300-volt, 60-cycle, three-phase generators, which were part of the old equipment, and one new 500-kw (rated for 85 per cent power factor), 2300-volt, 60-cycle, three-phase generator. At Shelbourne Falls, a distance of eight miles from Greenfield, the company has installed two 400-kw, 10,000-volt water-wheel driven generators. The company has also just completed a transmission line from the station located at Turner's Falls, a distance of 4½ miles. The plant at Turner's Falls has an aggregate equipment at present of about 200-kw.—*Gen. Elec. Rev.*, September.

Switchboard.—S. E. M. Henderson.—For the Salt River irrigation system a 6000-kw hydro-electric station has been erected to supply energy for the pumping plants. The author gives an illustrated description of the alternating-current switchboard in this station, which is an illustration of recent bench-control board construction. It is of the open type; that is, there is a space left between the instrument sections and the control bench, so that the switchboard operator can have an unobstructed view of any part of the generator room without going to the end of the board, which is located at the edge of the gallery, about 18 ft. above the main floor. The bench board is equipped for the control of the following circuits, the exciter switchboard being independent and of the ordinary vertical construction: six 2300-volt, 1060-kw, 25-cycle, six-phase, three-wire generators; six 2300-volt (delta-connected), 1060-kw, 25-cycle, three-phase banks of transformers, grounded neutral; and two 45,000-volt, 6000-kw, three-phase outgoing lines.—*Gen. Elec. Review*, September.

Tirrill Regulator.—A. A. Tirrill.—An article illustrated by diagrams on the principle of his well-known regulator. While it is mostly used now for maintaining constant voltage, it may also be used for maintaining constant current, constant watts and constant power factor.—*Elec. Jour.*, September.

Wires, Wiring and Conduits.

Undeground Mains.—J. R. Dick.—The first part of an illustrated serial on the design of underground mains and networks. The author considers the general design of a low-tension network. Having determined the probable positions and amounts of the loads, the sections of conductors are selected in accordance with temperature and pressure drop limits. Stepping of distributor cables is not necessarily advantageous. He then passes over to a discussion of the elasticity of networks. In designing the feeder system certain methods for the composition and resolution of currents taken from distributors are useful. Graphical methods are considered, and a rule for determining the best feeder areas is developed.—Lond. *Elec. Rev.*, Sept. 11.

Alternating-Current Underground Distribution. — S. D. Sprong.—The second part of his illustrated description of the alternating-current underground distribution system of the United Electric Light & Power Company, in New York City. The company has a maximum load of between 11,000 and 12,000 kw. The system has a connected load of about 661,000 16-cp lamps. The total operating efficiency of the system for 1907 was 76.2 per cent, taking into consideration all energy unaccounted for, including transformer losses, unmetered and stolen energy.—*Gen. Elec. Rev.*, September.

Copper Wire by Electrolysis.—See the abstract of the article by Cowper-Coles under Electrolysis.

Electrophysics and Magnetism.

Contact Rectifiers.—L. W. Austin.—The author formerly described an aluminum-tellurium contact capable of transforming small alternating currents of any frequency into direct current by means of what seems to be thermo-electric action. He points out that there are a large number of solid conductors in which, when brought together so as to form a contact of not too low a resistance, electricity appears to pass more easily in one direction than in the other. Silicon in contact with almost any of the ordinary metals, carbon in contact with steel, and tellurium in contact with aluminum, all show a well-marked and fairly regular unilateral conductivity. In studying these rectifying contacts the author uses two main methods. In the first, a direct e.m.f. is applied to the contact, first in one direction and then in the other, and the resulting currents are measured on a galvanometer or ammeter having resistances small in comparison with that of the contact. In the second method, a known alternating current at 60 cycles is sent through a fall-of-potential wire and the required voltages are taken from sliding contacts and applied to the rectifying contact, which is in series with the direct-current meter. In all the cases investigated the contact has a resistance of several ohms as though there were a resisting film between the conductors. In all the

cases, too, there is a comparatively poor conductor in contact with a good conductor, but the rectification in the cases of carbon-steel and of silicon-steel is from the good to the poor, while in tellurium-aluminum it is in the opposite direction—except for very low voltages where another phenomenon, perhaps thermo-electric, predominates. The first effect is in the same direction as the rectified current in the aluminum electrolytic rectifier. Another peculiar fact is that in the three cases studied the rectified electricity flows in opposition to the thermo-electric current produced by heating the contact, except in the case of tellurium-aluminum at low voltages. The phenomenon described is certainly a contact phenomenon, as it depends vitally upon the pressure and area of the contact surface. When the surfaces are sufficiently large and the contact sufficiently close, the rectification entirely disappears. The fact that the direct currents are in general proportional to the square of the alternating current seems to suggest in a general way a heat action.—*Bull. Bureau of Standards,* August (Vol. 5, No. 1).

Transmutation of Elements.—MRS. CURIE AND MISS GLEDITSCH.—An account of experiments in which they repeated the experiments of Ramsay, who thought he had found a transmutation of copper into lithium. By excluding all lithium initially from their apparatus and chemicals, they could not confirm Ramsay's results.—Translated from *Comptes Rendus* in London *Elec.,* Aug. 28.

Transmutation of Elements.—H. F. KELLER.—A Franklin Inst. paper giving a summary of those recent researches which seem to indicate the possibility of the transmutation of chemical elements.—*Jour. Franklin Institute,* September.

Double Refraction.—C. F. HAGENOW.—An account of an experimental investigation of differential electric double refraction in carbon bisulphide.—*Phys. Rev.,* September.

Electrochemistry and Batteries.

Calcium Carbide and Ferrosilicon.—W. CONRAD.—A long and profusely illustrated paper on the design of electric furnaces for the manufacture of calcium carbide and ferrosilicon in European practice. The author traces in great detail the development of the furnace design in different European countries. He thinks the following principles must be fulfilled in the design of large carbide and ferrosilicon furnaces: First, the electrodes must not be in immediate contact with the charge; there must be a layer of vapor between electrode and charge; this zone of vapor is the real zone of reaction. The most suitable furnace lining is obtained by cooling and slagging the layer of molten charge next to the walls. Air-cooling of the walls is used with carbide furnaces, while for ferrosilicon furnaces water cooling is often employed. It is preferable not to use the bottom of the furnace as one terminal of the circuit. Details are given of tapping by means of a special arc method and of various constructions of the electrode holders.—*Electrochem. and Met. Industry,* October.

Calcium Carbide.—E. ROSENTHAL.—An illustrated article giving some notes on the manufacture of calcium carbide and describing the Lanhoffer furnace.—*La Lumière Elec.,* Aug. 29.

Copper Tubes, Sheets and Wires by Electrolysis.—S. O. COWPER-COLES.—A fully illustrated paper in which the author first traces former attempts to produce finished sheet, tubes, etc., of copper by electrolysis from impure copper. The processes of Wilde, Elmore, Dumoulin and others are described, and the author then gives a full account of his new centrifugal process. It is based on the observation that copper tubes and sheets could be produced by electro-deposition on cathodes revolved at a high speed with the high current density of 200 amp per square foot. The methods of making tubes, sheets and wires by this process are described and illustrated. The chief advantage is that the necessity of again smelting the electrolytically-refined copper is done away with, as well as the chemical processes of rolling, drawing, etc.—*Electrochem. and Met. Industry,* October.

San Francisco Mint.—R. WHITEHEAD.—The conclusion of his long illustrated description of the electrolytic plant for refining gold, silver and copper at the United States Mint in San Francisco. In the present installment the melting-room equipment is described and a brief comparison is made of the electrolytic refining methods used at the different mints. The author thinks that the Wohlwill process of gold refining should prove a success in outside plants, especially as the platinum could be recovered.—*Electrochem. and Met. Industry,* October.

Steel Hardening Furnace.—C. R. STRAUBE.—An illustrated description of an electric furnace for hardening steel. It is a simple resistance furnace containing a salt bath, which is fused by the current. The article to be hardened is placed in this bath. Potassium chloride is used for carbon steels, barium chloride for high-speed tool steels. The latest improvement of this furnace is the possibility to connect it to a three-phase system. For this purpose the three-phase currents are changed within the regulating transformer by means of the Tee-method into two-phase currents, and the latter are supplied to the bath through four electrodes. The two pairs of two electrodes are placed along the four sides of the furnace.—*Electrochem. and Met. Industry,* October.

Removal of Sulphur in Electric Steel Furnaces.—T. GEILENKIRCHEN AND B. OSANN.—Two papers on the method of removal of sulphur in electric furnaces for steel refining. Geilenkirchen gives an account of the daily practice with the Heroult furnace in a German steel works, while Osann describes the method employed with the Roechling-Rodenhauser modification of the induction furnace in another German steel works. Considerable details are given of the various reactions which contribute to the removal of the phosphorus and sulphur; also the views of J. Harden on the subject.—*Electrochem. and Met. Industry,* October.

Diffusion of Salts.—R. HASKELL.—A paper on the effect of concentration and ionization on the rates of diffusion of salts in aqueous solution. The author describes a method for the direct determination of the specific diffusion rates or diffusion constants of both the undissociated and the dissociated portion of partly ionized substances. The method consists in allowing the salt to diffuse upward into a long cylindrical tube initially filled with pure water, keeping the concentration constant at the lower end. The concentration of the electrolyte is determined at different times and at different points along the tube by measuring the electrical conductance between platinum wires arranged in pairs and placed at different distances along the tube. The theory of the author is based on Nernst's osmotic theory of diffusion, but takes into account both the dissociated and non-dissociated molecules, and from experiments with thallium sulphate and barium nitrate it appears to follow that the rate of diffusion of the undissociated substance is one-half that of the ionized portion.—*Phys. Rev.,* September.

Units, Measurements and Instruments.

Electrical Standards.—R. T. GLAZEBROOK.—A report of a committee of the Brit. Asso. for the Advancement of Science on experiments for improving the construction of practical electrical standards. In extended experiments it has been established that to a very high degree of accuracy the e.m.f. of the Weston cadmium cell, as set up at the National Physical Laboratory, when expressed in terms of the ampere (10^{-1} c.g.s. units of current) and the international ohm is 1.0183 at a temperature of 17 deg. C. Further, it has been shown that cells can be prepared by different persons in different countries which will agree in e.m.f. to 2 parts in 100,000. By comparison of six different forms of silver voltameter it has been shown that the silver deposited by a current of 1 amp in all these various forms was the same if proper precautions were taken; it amounts to 1.11827 mg per second. A full account is also given of tests of the constancy of the standard resistances, especially the manganin resistances.—Lond. *Elec. Eng'ing,* Sept. 10.

Ohm, Ampere, Volt.—Full reprints of the specifications proposed by a committee of the Brit. Asso. for the Advancement of Science "for the practical realization of the definitions of the international ohm and international ampere, and instructions for the preparation of the Weston cadmium cell." These specifications are intended to serve as a basis for discussion at the International Conference to be held next month.—Lond. *Elec. Eng'ing,* Sept. 10.

Cooling Curves.—G. K. Burgess.—The conclusion of his long illustrated article on different methods of obtaining cooling curves. It seems that the one cooling curve from which the most comprehensive view of a transformation can be obtained is the simple curve which gives the temperature as function of the time, if it is made sufficiently sensitive. The cooling curve which gives the least information is the temperature-rate curve. Those curves which cannot readily be recorded directly by any form of instrument yet devised are the inverse-rate curves and the derived differential curve. The one curve that can be made the most sensitive and certain is the differential curve. It is, therefore, preferable to combine the temperature-time observations with those obtained by the differential method.—*Electrochem. and Met. Industry,* October.

High-Tension Continuous Oscillations.—R. C. Galletti.—An account of experiments in which the author succeeded in producing high-tension continuous oscillations suitable for wireless

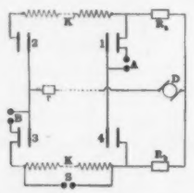


FIG. 3.—ARRANGEMENT OF APPARATUS FOR TESTS.

telegraphy by means of a 25,000-volt, 114-amp direct-current Thury generator. The arrangement used by the author is shown in Fig. 3. It comprises four identical condensers, 1, 2, 3, 4, and two spark micrometers *A* and *B*. Discharging the condenser 1 across the spark-gap *A* produced a series of oscillations in the circuit 1, *A* and another induced series in the circuit 1, K^1, 2, 3, *K*, 4 syntonized to the same period. Since the decrement of the latter circuit was very small, the maximum oscillation in it coincided with the final oscillations in 1, *A*. The same thing happened on discharging the condenser 3 across *B*. Hence at the end of every discharge across either *A* or *B* there was a maximum oscillating potential induced on the balls of the opposite spark-gap. The fixed distance between the balls of the spark-gap was the striking distance of a certain static electric charge at a certain tension produced by the working of the generator at a certain interval determined by the capacity in parallel with the gap, the resistance in series with the generator and the tension of the latter. The presence of an oscillating potential induced on the balls of the spark micrometer gives a striking distance which is virtually smaller. This virtual striking distance was least for *B* at the termination of the *A* spark, and least for *A* at the termination of the *B* spark. On increasing the tension of the generator and thus providing a sufficient number of sparks per second at either *A* or *B*, it happens at a certain instant that the partial static charge discharges itself prematurely on account of the lesser virtual striking distance. This was made evident by the diminution of the striking distance of the test-gap *S*, which measures the charging potential of the capacity of the closed circuit. On calculating the quantity of electricity which should have passed per second through the circuit 1, K^1, 2, 3, *K*, 4, while it was the seat of continuous oscillations of the potential indicated by the test-gap, it was found to agree with the quantity measured by means of a fuse inserted in the same circuit. Such a fuse was composed of several lead wires 0.5 mm in diameter and was tested by comparison with a 0.1 mm copper wire at high frequency. The resistance shown in the diagram was introduced in order to direct the path of the oscillations and to facilitate the interpretation of the phenomena observed.—Lond. *Elec.*, Aug. 28.

Driving a Testing Machine.—J. A. Capp.—In view of the numerous tests now made, the proper driving of the testing machine and its speed control are important. The adjustable-speed motor and controller present a very satisfactory solution of the whole problem of speed of testing. A 3-to-1 range of speed, obtainable by easy gradations (not jumps) by the turning of the handle of the controller, permits the operator to drive his machine at that speed at which he can most certainly and accurately keep the beam floating in balance. Once past the yield point, the throwing over of the speed clutch and simultaneous slowing down of the motor enables him to pick up the load at about the same speed as before, and to increase it gradually as the stretch-rate increases, thus keeping the travel of the poise up to about the maximum rate consistent with accuracy. Operating under these conditions, testing may be done without risk of errors due to guessing, and the time of testing is reduced to the lowest practical limit.—*Gen. Elec. Rev.*, September.

Singing Arc.—G. W. Nasmyth.—A long mathematical paper in which the author shows that the common, simple formula for the frequency of the singing arc is only approximate and that in general a more complicated formula holds good. From this more general formula of the author, the characteristic properties of the singing arc may be deduced. In practical application, the formula shows that when a large change of frequency is desired with a small change of arc current, as in certain systems of wireless telephony, the inductance of the shunt circuit should be very small. If steady conditions of tuning are desired the inductance of the shunt circuit should be large.—*Phys. Rev.*, August.

Application of Ionization Phenomena for Measuring Temperatures.—O. W. Richardson.—The great simplicity of the fundamental relations between the ionization from hot bodies and their absolute temperature makes it possible to use the phenomena of ionization for measurement of high temperatures. The author discusses two possible methods. The first method of applying the emission of ions to the measurement of temperature is analogous to the application of the measurement of the vapor pressure of a liquid for the same purpose. The second method consists in measuring the kinetic energy of the ions emitted by the hot metal. If the theoretical foundation of this second method is sound, it is a truly absolute method independent of the properties of any particular substance.—*Phys. Rev.*, September.

Telegraphy, Telephony and Signals.

Polytelephonic Circuit.—E. Mercadier.—The author has formerly shown that by means of electric tuning forks and suitably tuned telephones half a dozen simultaneous messages can be sent over the same wire. He now reports an extension of this system. It is now possible to transmit messages from Paris to Marseilles from a dozen instruments over the same wire, and to record them at the other end by as many Morse or Hughes recorders. The system is particularly elegant. A small lever presses lightly against the tuned telephone disk. When the disk vibrates, the lever is repelled and does not resume lasting contact until the vibration has ceased. If the lever works a direct-current relay, the alternate current transmitted is practically converted into a direct current suitable for a Morse recorder. The energy consumed is small; six accumulators suffice for working the whole apparatus, the line resistance being 1 ohm per kilometer.—*Comptes Rendus,* Aug. 10; abstracted in Lond. *Elec. Eng'ing,* Aug. 20.

Induction from Transmission Line.—A note describing the method used by the Oregon Electric Railway Company for overcoming the effects of induction from a 33,000-volt transmission line on the operation of a grounded telegraph wire strung on the same pole line, the transmission wires not being transposed. The telegraph circuit is 50 miles long and "is supplied with energy from the main battery at Portland from one side of a three-wire grounded neutral lighting system in the general office building and 30 cells of gravity battery at Salem." At intervals of about every 10 miles a 2-mf condenser is connected, one side to the line and the other to ground. These condensers are stated to take care of the induction effectively.—*Elec. Railway Jour.*, Sept. 19.

Miscellaneous.

British Association.—The first part of an account of the proceedings of this year's convention at Dublin of the British Association for the Advancement of Science. The presidential address

of F. Darwin dealt with subjects of a botanical character and especially with movements of plants. Dr. W. N. Shaw's address to Section A referred to the troubles experienced in running an institution which depends almost entirely on collecting observations. It meets the difficult problem of distinguishing between observations which may form useful material in the future and those which will not. Dr. Clerk's address to Section G gives an outline of the development of thermodynamics with reference to the steam engine. F. S. Kipping's address to the chemical section deals with the difficulty of the chemical industries in Great Britain and some effects of the new British patent law. Lond. *Elec.*, Sept. 4.—Clerk's address on thermodynamics of the steam engine is printed in Lond. *Eng'ng*, Sept. 4.

Marine Exposition.—F. Thilo.—The first part of an illustrated article on exhibits at the recent marine exposition in Berlin. The direct-current system is generally used in shipboard, and as a prime mover the steam turbine is gradually replacing the reciprocating engine. For producing a high vacuum for the steam turbine, rotary air pumps find steadily increasing application. While the problem of the electric driving of the propeller has not yet been satisfactorily solved for large ships, it is used on smaller boats. Besides various lead cells, the Edison iron-nickel battery was also exhibited. Some notes are given on switches, fittings, etc., exhibited.—*Elek. Zeit.*, Sept. 10.

NEW APPARATUS AND APPLIANCES

Combined Indicating and Recording Instruments.

The type of instrument illustrated herewith combines in one device both indicating and recording features, each consisting of an edgewise indicating and a curve drawing instrument. The instrument movement is of the standard type, a light tube

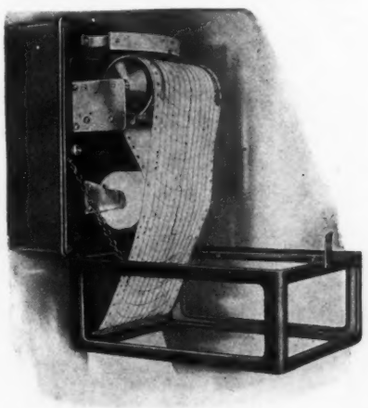


FIG. 1.—COMBINED INDICATING AND RECORDING INSTRUMENT OPENED FOR INSPECTION.

being substituted for the pointer. The movement is enclosed in a dustproof case, which contains also the clock mechanism used to control the speed of the paper and the movement of the inking pen.

The "movement" of a direct-current instrument is shown in

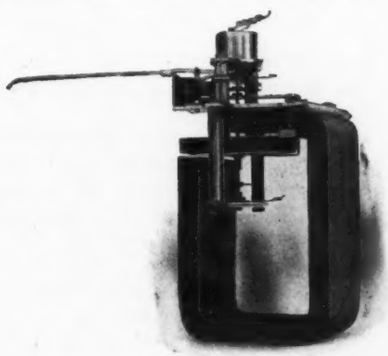


FIG. 2.—MOVEMENT FOR DIRECT-CURRENT INSTRUMENT.

Fig. 2. The tube is mounted on pivots, carried in a support fastened to the moving element of the instrument. The inner end of the tube dips into a stationary ink well, while the outer end terminates in an inking pen. The ink is drawn from the ink well and carried through the tube to the pen. The pen is normally free from the paper. On the support which carries the tube is mounted a small soft-iron armature, above which is a small electromagnet. Every half second the clock closes a circuit through the coil of this magnet, which attracts the small armature, bringing the pen on the end of the pointer in contact with the record sheet, thereby making a record of its position. It will be seen, therefore, that the pen is in contact with the paper for only a small part of the time, and is otherwise free to swing. On the tube near the pen is mounted also the indicator which moves in front of the scale, forming an edgewise indicating instrument.

The method used for "feeding" the paper is such that no

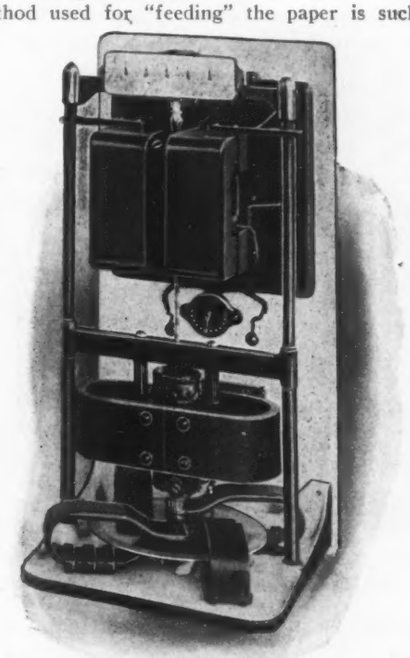


FIG. 3.—WATT-HOUR METER WITH WATTMETER ATTACHMENT.

drag is placed upon the clock mechanism. The paper passes over a drum 3 in. in diameter, provided with projections which engage holes in the edge of the record sheet. This roll is driven by a small worm gear which is actuated by a ratchet wheel, the pawl of which is the armature of a small electromagnet in circuit with the one which gives the pen its movement.

The current required by the two magnets is claimed to be only 0.07 amp, at an e.m.f. of 4 volts, the power required to feed the paper being about ¼ of a watt. The current for the magnets is usually supplied by connecting across one or two steps of a field rheostat of one of the machines in the plant, or it can be obtained from a pair of dry cells. No other controlling circuits or anything of the kind are required.

As shown in Fig. 1, the front of the case is hinged, so that

the case can be opened and closed without removing the record sheet. The instruments are made as direct-current or alternating-current ammeters, voltmeters or wattmeters, power-factor meters, frequency meters, totalizing meters or pyrometers.

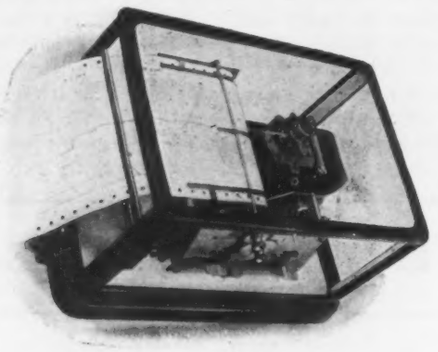


FIG. 4.—PORTABLE TYPE OF RECORDING METER.

The instruments are also made in the portable type as shown in Fig. 4.

The totalizing instrument is a special form of magneto generator and voltmeter combined with a watt-hour meter. Mounted on the spindle of a watt-hour meter is a small magneto armature, the iron core of which is stationary and supported from the frame of the watt-hour meter. The armature revolves about the stationary core of a permanent magnet. Obviously the magneto armature will develop an e.m.f. proportional to the speed of the meter disk and therefore proportional to the rate at which energy is passing through the watt-hour meter. A recording milli-voltmeter connected to the small magneto will draw on the chart a curve of the watts of the circuit. If there are several generators in a plant each with its watt-hour meter, the magnetos can be connected in series and the recording instrument will show the total wattage of all the generators. It does not matter whether the watt-hour meters are for alternating or direct current, inasmuch as the small magneto circuits are entirely separate from those of the watt-hour meter. Fig. 4 shows a 500-amp, 500-volt watt-hour meter with the wattmeter attachment.

These instruments are manufactured by the Central Laboratory Supply Company, Lafayette, Ind.

Tungsten Miniature and Low-Voltage Lamps for Battery Service.

Almost a score of types of low-voltage tungsten lamps have been developed by the Buckeye Electric Company, some of which are shown in the accompanying illustrations. One of the types has been especially designed for use on automobiles and motor-boats to displace the oil and acetylene lights at present in use. The new lamps are operated on ignition storage-batteries, low-tension ignition magnetos or ignition generators; the last-mentioned method is much better, and involves the use of a special battery. There is very little expense in changing the equipment from oil or gas. Special parabolic reflectors are used which enable the lamps to be focused to give any desired distribution. While the 6-volt lamp for automobile and motor-boat is the general standard, 4-volt and 8-volt are also satisfactory; the candle-power runs from 2 to 16 or even to 24 if desired, the lamps operating at approximately one watt per candle. In practically all cases a 100-amp-hour battery is sufficient.

For train-lighting there is practically a saving of two-thirds the current as compared with the carbon lamp, the best results being obtained from operation at about 30 volts. Moreover, the breakage is stated to be no greater than with carbon lamps used at 30 volts. Train-lighting lamps are designed in various types from 12 to 48 cp, in bulbs from 1½ in. to 3 in. in diameter, and in efficiencies from 1 to 1¼ watts per candle-power.

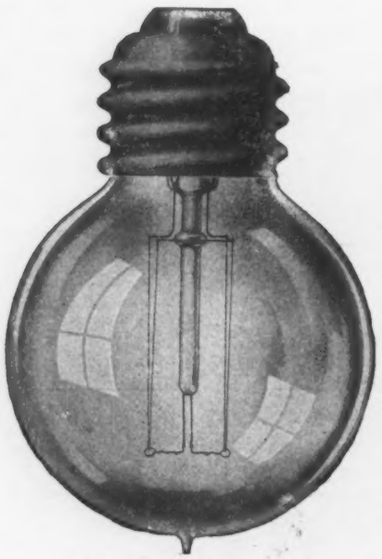


FIG. 1.—24-CP 20-VOLT LAMP.

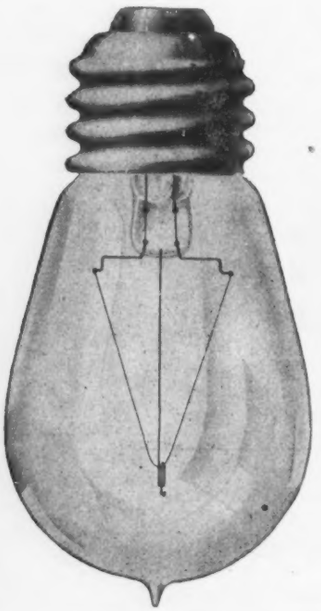


FIG. 2.—8-CP 20-VOLT LAMP.

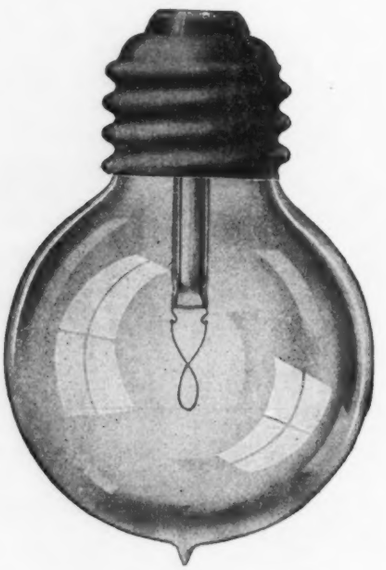


FIG. 3.—4-CP 4-VOLT LAMP.

For dental and medical uses the low candle-power miniature tungsten is operated from dry batteries, which will last three times as long as when connected to a carbon lamp of equal candle-power. The tungsten lamps for dental and medical use have the important advantage of developing only about one-third of the heat of the carbon lamp.

Among other uses these lamps are for pocket flashlights with small batteries; for decorative purposes, as on Christmas trees, where batteries are used, and as novelty lamps.

New 25-Watt Tungsten Lamp.

An addition to the line of tungsten incandescent lamps for standard lighting circuits (100 to 125 volts) is being placed on the market by the General Electric Company. This is a 25-

watt, 1 to 1¼ w.p.c. lamp made in a practically identical bulb to that used for the ordinary 16-cp carbon lamp. The lamp has the same diameter and base and approximately the same length as the familiar 16-cp unit.

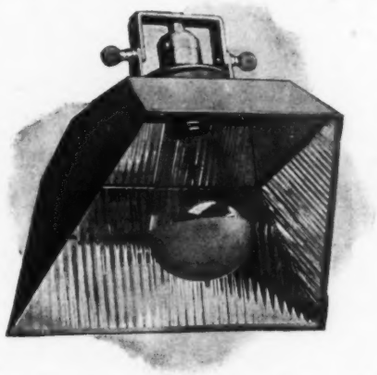
This lamp will burn in any position and its size adapts it for use in any shade or fixture suitable for the 16-cp carbon lamp. It can be substituted, therefore, lamp for lamp, in all present installations.

At 1¼ watts per candle the 25-watt lamp gives 20 cp, or 25 per cent more light than the ordinary 16-cp lamp. The energy consumed is one-half that of the best 16-cp carbon lamp and considerably less than one-half the energy consumed by a 16-cp carbon lamp of similar life—800 hours.

The General Electric Company, as previously announced, has been greatly increasing its manufacturing facilities and is now prepared to manufacture this lamp, together with the 40-, 60-, 100- and 250-watt lamps, at the rate of 35,000 lamps total output per day. The stock of the new 25-watt tungsten is at present somewhat limited, but the factory capacity is ample to maintain a reasonable delivery on all ordinary orders.

Window-Reflector for Tungsten Lamp.

Among the distinctive characteristics of the tungsten lamp which have been considered in the design of the reflector illustrated herewith are the pendant position of mounting and the horizontal direction of the maximum light radiation. The reflector has been so constructed that all of the light radiated toward the base is reflected downward, that from the three sides is thrown forward and downward, while that from the



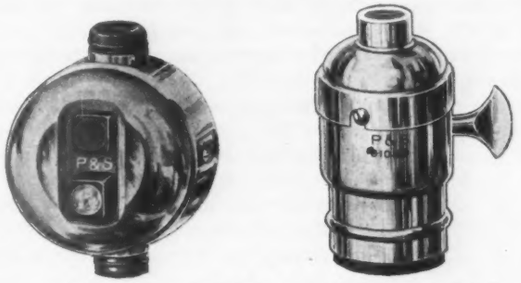
WINDOW REFLECTOR FOR TUNGSTEN LAMP.

remaining side is radiated horizontally without interference. The reflector is equipped with a hinged holder attached above the socket, which permits adjustment of the reflector to any angle. It is claimed that when this reflector is placed around a 100-watt tungsten lamp ample light is provided for the average show window. This reflector has been developed by the Wheeler Reflector Company, 156 Pearl Street, Boston, Mass.

Cord Switch and All-Metal Key Socket.

Among the latest Pass & Seymour circuit fittings are the cord switch and key socket shown in the accompanying illustration. The first-mentioned is also known as a "feed-through switch" from the fact that the cord passes through the switch. The uses for such a switch are many, and particularly with small sewing-machine motors, stereopticons, heating devices, etc., where it is desirable to cut a switch into the cord instead of placing the switch at the end of the cord or using a wall switch. The device is wired-up by simply passing the cord into the upper bushing, connecting one wire to terminals and passing the cord out through lower bushing; only one wire is cut, the other passing right through. The device conforms to National Code requirements.

The socket shown is stated to be the only one on the market with an all-metal key, the design being such that the mandrel is at all times "dead." This device appeals particularly to manufacturers of fixtures, portable and the like, who wish a socket



FIGS. 1 AND 2.—CORD SWITCH AND KEY SOCKET.

with a key to match the finish of the fixture. All Pass & Seymour brass shell sockets and receptacles may be equipped with this key.

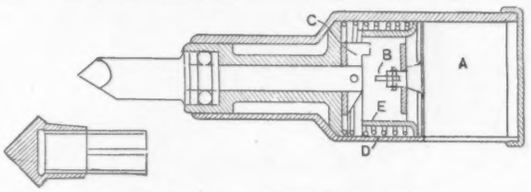
Clamp for Ceiling Outlet Boxes.

A device for fastening ceiling outlet boxes to the dummy or gas pipe has recently been put on the market by the Federal Electric Company, of Chicago, in order to eliminate many of the difficulties experienced in installing boxes in the old way. It is claimed for this device that it will save from 10 to 15 minutes of time in installing each box, as the clamp is quickly fastened by tightening one set screw.

The outlet box is held firmly in position at right angles to the pipe, so that there is no chance of breaking the plaster by swaying fixtures. The opening where the pipe passes through the box is also filled up, thus preventing flames from being drawn up through it in case of a fire started by a short circuit or loose contact. The trouble of threading dummies 3 in. or 4 in. from the end is avoided. The clamp is made in two sizes, ⅜ in. and ½ in., with two lugs for ordinary purposes and three lugs for heavier work, such as in fireproof buildings. The device has been approved by the Underwriters' Laboratories.

Speed Counter for Electric Machinery.

The Veeder Manufacturing Company, of Hartford, Conn., has just put on the market an improved speed counter which should be found particularly useful in connection with electrical machinery. The counter is provided with a special rubber tip which insulates it thoroughly from the electrical machine. The accompanying illustration shows a sectional view of the device in which *A* is one part of the clutch and *B* the complementary part. The clutch feature makes the counter entirely different from others on the market, and enables the operator to place the point of the counter against the shaft at any time without having the registering device begin to operate until



SECTIONAL VIEW OF SPEED COUNTER.

desired. The registering is started by pressing on the end of the counter; this enables the operator to hold the counter in one hand and his watch with the other, and give his entire attention to the watch. The counter continues indicating as long as the pressure is maintained on the end; as soon as the pressure is released, the helical spring shown separates the two parts of the clutch, thus throwing the register out of engagement and stopping the count instantly. The registering device is the well-known revolution counter made by the Veeder Company, and, it is said, will safely stand a speed of 5000

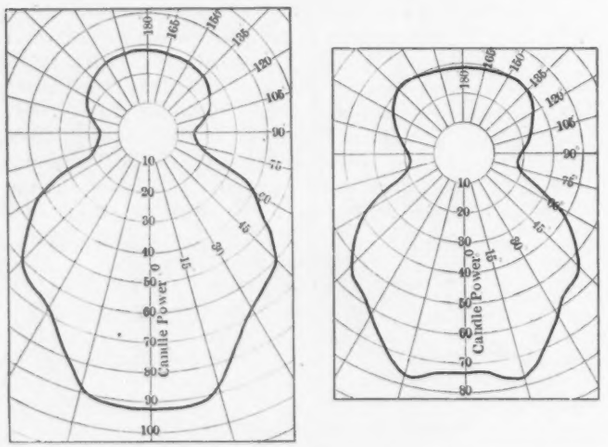
r.p.m. This speed is high enough to take care of most electrical machinery. No arrangement is provided for setting the instrument back to zero; this is not necessary because the reading of the counter can be taken before beginning a count and also at the end of the period over which the count is made. The difference between the two readings will be the number of revolutions made by the revolving shaft in the given period. The use of any arrangement for setting the counter back to zero would render it unreliable. The counter works equally well running in either direction; when running in one direction it adds, and when running in the other direction it subtracts; in either case the difference between the two readings is the number of revolutions of the shaft. It will be found quicker to find the difference between the two readings than to set the counter back to zero. As the register is a direct-reading instrument having all the figures in line, no mistakes are liable to be made in taking the readings.

Opal Bowl Reflectors for Tungsten Lamps.

The Phoenix Glass Company has recently brought out some bowl-shaped reflectors of sufficient size for tungsten lamps of 40 watts to 100 watts. One of these reflectors is shown in Fig. 5. It is 8 in. in diameter by 6 in. deep, and is similar in

FIG. 1.—OPAL BOWL REFLECTOR.

shape and illuminating performance to the prismatic bowl reflectors now in common use. These reflectors are made either in plain opal or opal sand blasted on the outside. The latter reflector gives a very soft, pleasing effect, though, of course, catches dirt more readily than the reflector with the plain finish. Tests of the reflectors, both plain and sand blasted,



FIGS. 2 AND 3.—DISTRIBUTION OF LIGHT FROM 60-WATT LAMPS EQUIPPED WITH SAND-BLASTED OPAL AND PLAIN OPAL REFLECTOR.

with 60-watt and 100-watt tungsten lamps, have been made by the Electrical Testing Laboratories, and are shown herewith, Figs. 1 to 4. Tip-frosted lamps were used in each test. The 60-watt lamp was operated at a voltage which gave 44.6 mean horizontal candle-power, and the 100-watt lamp at 78.8 mean horizontal candle-power, these being the average candle-power values of tip-frosted lamps of this type, which gave their rated mean horizontal candle-power at the same voltage before being frosted. Thus the lamps would have operated if not frosted at the rated 48 and 80 mean horizontal candle-power, respectively.

Fig. 1 shows the distribution of light about an opal reflector, sand blasted outside, with 60-watt tip frosted tungsten lamp.

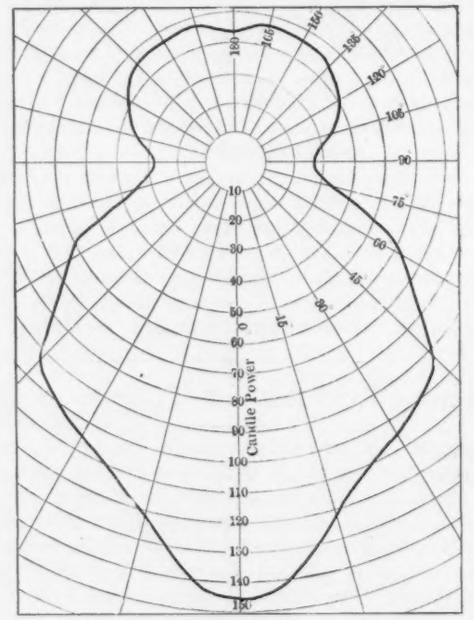


FIG. 4.—LIGHT DISTRIBUTION FROM 100-WATT LAMP EQUIPPED WITH SAND-BLASTED OPAL REFLECTOR.

Fig. 2 shows the distribution of light with a plain opal reflector with the 60-watt tip frosted lamp. It will be noticed that a larger percentage of the light is reflected downward with the frosted than with the plain opal. The sand blasted reflector (Fig. 1) delivers about 57 per cent of the total light below 75

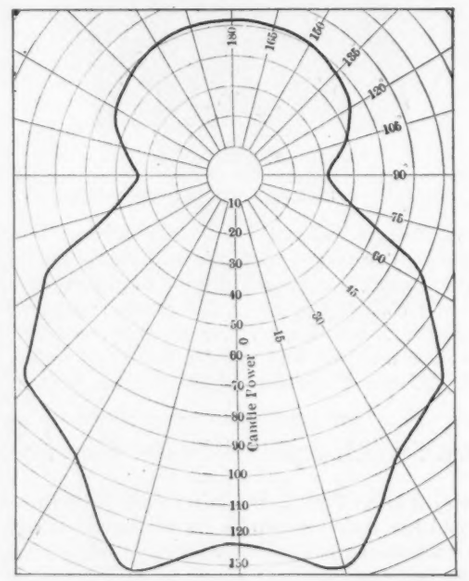


FIG. 5.—LIGHT DISTRIBUTION FROM 100-WATT LAMP EQUIPPED WITH PLAIN OPAL REFLECTOR.

deg. from the vertical, and the plain reflector delivers about 52 per cent. A large percentage of the light which passes through the reflector, however, is directed upward toward the ceiling near the lamp, so that with light ceilings much of it would be reflected downward from the ceiling. The flux of light horizontally is small, which is desirable from the standpoint of useful light efficiency.

Fig. 3 shows the distribution of light with the same reflector, opal sand-blasted outside, equipped with the 100-watt tip frosted tungsten lamp. Fig. 4 shows the distribution with the plain opal reflector.

The reflectors were held in the position which would be obtained with the use of a Form H holder. These reflectors are made sufficiently dense so that the lamp filaments cannot be seen through them; hence they serve as excellent diffusers and softeners of the light. They are also made in smaller sizes. The company is making flat distributing reflectors of similar shape to the flat, distributing prismatic reflectors used on Gem and tungsten lamps.

Remotely Controlled Circuit-Breaker.

The circuit-breaker illustrated herewith has been developed for use under conditions requiring a device to open the circuit of a motor on overload which can be controlled from a distance by the operator at the machine and can absolutely be held open by the operator at the machine, regardless of the man in charge of the motor. Inasmuch as an absolute interlocking of the machinery was necessary, no chances could be taken of the motor being started when men were working about it. The circuit consists of two single-pole breakers and a dummy pole, all being movable by the same handle. Each of the single-pole breakers is equipped with an overload coil, and the operation of either overload coil opens the breaker. In addition, the breakers can be instantly opened by throwing the handle up. In addition to these two overload coils there is placed on the dummy pole a shunt tripping coil designed to be left in circuit continuously without injury. Upon closing the circuit through the shunt closing coil, the middle pole is tripped out and this in turn trips out both of the active poles, thus opening the breaker. Moreover, the handle is locked down by an auxiliary latch in such a way that it cannot be closed down until current from the shunt-tripping coil is de-energized, thereby allowing the core to drop. It is thus impossible for anyone to close the circuit-breaker so long as this coil is energized.

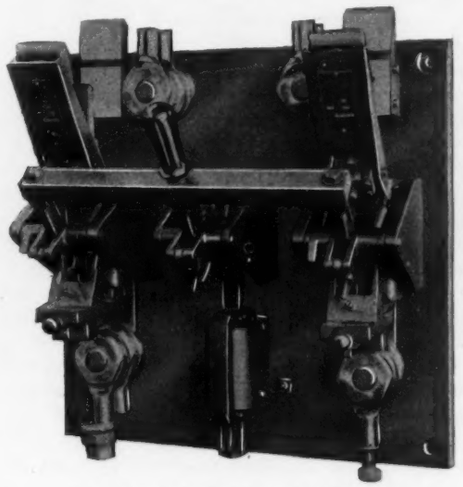


FIG. 1.—CIRCUIT-BREAKER OPEN.

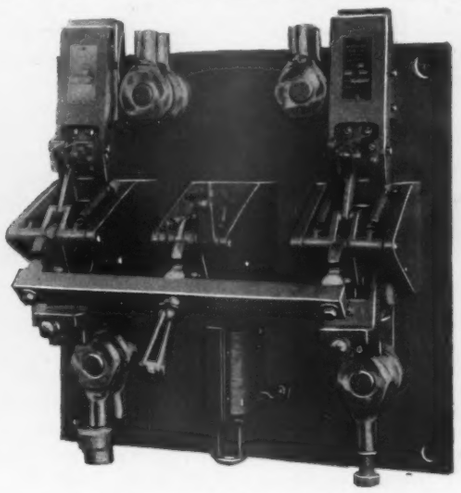


FIG. 2.—CIRCUIT-BREAKER CLOSED.

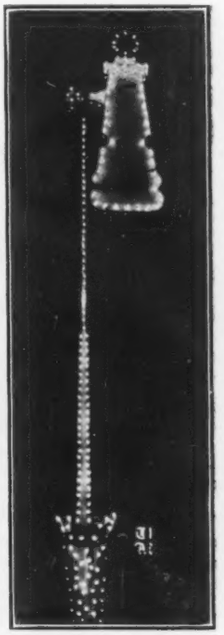
In a particular application in a mining equipment small knife switches were placed at various points, each switch closing the circuit through the shunt tripping coil. Whenever it is desired to stop the machine and hold it in a stationary position, one of the small switches is closed, thereby immediately opening the breaker and locking it permanently open until the switch is opened. The breaker is controlled entirely from alternating-current circuits, no direct current being necessary; it serves for opening two leads of a three-phase circuit. The breaker is adapted for mounting directly on the wall, the connections being on the face of the panel.

The above described breaker has been produced by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., from its standard apparatus.

Vertical Soda Water Sign.

An interesting soda water sign, strong in its appeal to the thirsty, has been installed by the Montgomery (Ala.) Light & Water Power Company on the streets of that city. It was designed by the sign department of H. L. Doherty & Company, of New York City, and was built to specifications by the Valentine Electric Sign Company, of Atlantic City, N. J. et

The sign is 31 ft. long and contains 422 4-cp lamps. About half of these lamps are on a Reynolds-Dull flasher. The moving effect starts at the spigot of the fountain and runs into a 6-ft. glass, from which the soda appears to effervesce. The border of the glass is in red lamps, the circles in the fountain are in green lamps, the outer border of the fountain is in white lamps, and the running stream is in white frosted lamps. This sign is suspended in front of a three-story building. It is a two-faced sign and the effect is beautiful, approached from either direction.



SODA WATER ELECTRIC SIGN.

Regulating Socket for Small Motors.

The regulating socket illustrated herewith is larger, though similar, to the regulating socket made for incandescent lamps by the same manufacturer, Charles Wirt & Company, of Philadelphia, Pa. The socket is intended for small motors and large lamps. The register used to regulate the amount of current fed to the device connected to the socket, consists of fine wire embedded in "Dielite" or molded stone. The resistance is increased or decreased within the limits of the device by turning the milled fiber ring shown at the bottom of the socket. The contact spring is made up of 30 per cent German silver, tempered, and the case is a thick brass shell, the complete socket being insulated and protected so that contact with live parts when manipulating the device is impossible. The contact bars are said to be of ample size and the construction solid and substantial throughout.

REGULATING SOCKET.

New Westinghouse Lamp Factory at Watsessing, N. J.

Good light, pure air, and pleasant surroundings were points kept in mind by the architects and engineers when they designed and constructed the works of the Westinghouse Lamp Company, at Watsessing, N. J. A visitor to the works is impressed by the unusually favorable condition under which the employees work. Tidiness is noticeable in every department. There is no crowding of employees; no foul air to make the

FIG. 1.—VIEW OF MAIN BUILDING AND STORAGE BUILDING.

employees drowsy and inefficient long before the day is done. High ceilings and plenty of windows make it possible for all to work in rooms well ventilated and always filled with a plentiful supply of pure air. Although these new works of the company have been operating but a few months, it is stated that the reports of output in quantity and quality of the product stand as conclusive evidence that an employee will do more work and better work if placed amid surroundings that are healthful and inspiring.

The plant, which occupies a level site comprising 15 acres of land, consists essentially of three structures—a main manufacturing building, 521 x 100 ft., three stories high, with a floor-to-floor height of 17 ft. 4 in.; a storehouse, 140 x 80 ft., four stories high; and a power house, 83 x 66 ft. The foundations of the buildings have been made of sufficient strength to permit the addition of one or more stories when desirable. All buildings were designed to be as nearly fireproof as possible, being constructed throughout of reinforced concrete.

Lighting and heating are supplied from a central power plant, which furnishes current for elevators, pumps, fans, and for manufacturing operations.

The power house is directly back of the storage house and is designed to contain 1000 hp of Stirling boilers. The following installation furnishes the necessary power for the operation of the works at the present time: One 250-kw and one 50-kw direct-connected Westinghouse alternator, the former having a 25-kw and the latter a 10-kw exciter; one 90-kw belt-driven generator; one 40-hp Westinghouse motor-generator set to supply direct current; one steam-driven air compressor, supplying air at from 3 lb. to 5 lb. pressure for blow-pipe work; one motor-driven air compressor, belt connected, to supply air at 100 lb. pressure for distribution through the manufacturing building. As a part of the power equipment, although placed in the manufacturing building in the south end of the first floor, are 17 electrically-driven vacuum pumps.

All mechanical processes are operated by electric drive, and the latest and best appliances used in lamp manufacture have been secured. Many of the machines used in these new works have been developed by the company's engineers, and the company has built the machines at the works. The factory is therefore designed and equipped to meet the best present-day methods in lamp manufacture.

In the boiler room are located the feed pumps, feed-water heaters, hot-water heater and circulating pump for the heating system in the buildings, and the mechanical draft apparatus.

The buildings are heated by indirect radiation, large stands of heating stacks being provided on the ground floor, through which the outside air is drawn by electrically-driven fans and distributed in galvanized iron ducts through all parts of the buildings. Hot water is circulated through the heating stacks by an electrically-driven centrifugal pump located in the boiler room of the power house, where the water is heated by exhaust steam. On the top floor of the main building, where there are a large number of operatives, and where the manufacturing processes require a considerable number of open flames, an additional mechanical ventilating system is installed.

In the manufacturing building all rooms are made especially light, large and airy, and are finished in light gray. Toilet accommodations, carefully designed and equipped with a view to health and comfort, are provided at convenient points on all floors. Drinking water is furnished on all floors at convenient intervals, from a well drilled to a depth of 550 ft. on the company's property. This well supplies all the water needed for manufacturing purposes and fire protection.

The storage house is the first building to be seen coming from the railroad station. It was purposely placed adjoining the tracks of the D., L. & W. R. R. and the Erie R. R., to facilitate the loading and unloading of material.

In the storage house are received and stored all the raw materials required in lamp manufacture. Starting at the storage house and ending in the same building is the best system of shop routine known to the art of lamp making. There is no back action to impede the work, and every step is in one forward direction. There is interwoven with the manufacturing process so closely as to be part and parcel of it, a system of inspection and accounting, by means of which every important operation is inspected and approved by an expert before it is permitted to pass on to the next operation. A space on each floor of the main building nearest the storage house, about 30 ft. wide and running almost its entire length, is reserved for the stores and inspection department. This space is fenced off from the manufacturing sections, and only those employed to

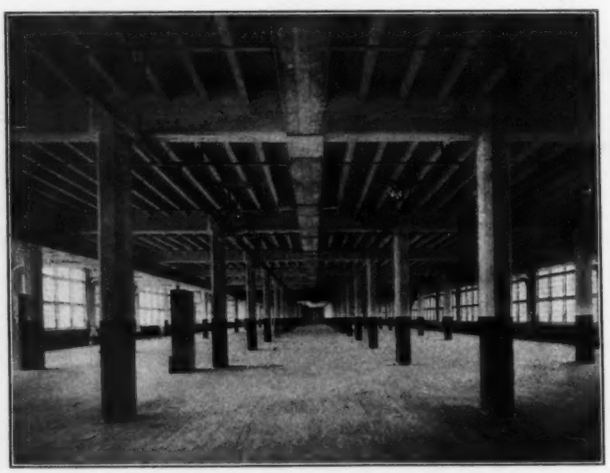


FIG. 2.—VIEW OF FACTORY FLOOR BEFORE OCCUPANCY.

inspect or to keep record of the work are permitted within the enclosure.

The above provisions not only assure a very high grade of product, but at the same time effect a great saving to the manufacturer in preventing further operation on pieces once found defective. They also make it possible to operate the factory on the premium piecework system. Careful record being kept of the grade of work turned out by each operative, the inspector once a month is able to prepare for the management a statement showing clearly the quantity and grade of work

turned out by each employee, as well as the standing of one employee with another in the same class of operation.

The process of making the lamp filament begins on the first floor of the main building. Here the filament undergoes 14 operations, beginning with the preparation for the brew, the squirting into fiber, its washing, and later the winding of the fiber on drums which are electrically driven, each drum having one attendant to feed the fiber. Other operations, including the forming of the filament on frames, then the packing, first for the preliminary furnaces and later for the final furnaces, then the sizing, cutting and counting. The counting is done by

FIG. 3.—LAMP BASING DEPARTMENT.

weight, and is correct within 2 per cent, which is far more accurate than would be counting by hand.

The treating of the filament takes place on the second floor at the south end of the main building. Here there are four long treating tables, each providing room for eight operatives. Each operative has facilities for treating simultaneously four filaments in separate chambers of hydro-carbon gas. After this, inspection is made as to the length and cross section of the filament, and a check inspection is also made for resistance, bad shapes, etc.

Reference should next be made to the process necessary to make the stem through which the leading-in wires are inserted before being sealed in the glass bulb. Glass in long tubes is cut into short lengths and fed into what are known as flanging machines. In point of economy of operation these are most interesting, being entirely automatic and requiring but one attempt to keep them filled and in adjustment. The hoppers at the top of the machines are kept filled with these short lengths, which, as they pass through the apparatus, are heated on one end by gas flame and mechanically flanged.

After the insertion of the platinum-tipped leading-in wires, the anchor wire and the forming of the seal by an automatic clamping attachment which is a part of the stem-making machine, the finished stems pass through an inspection and stores department to long tables for the mounting of the filament. Here the stems are arranged in frames and the filament attached preparatory to the straightening of the leading-in and anchor wires. From this point the mounted stems, containing the leading-in wires, anchor wires and filament, are passed through an inspection department to the sealing-in machines. The glass bulbs, after having been washed and placed in the stores and inspection department, are taken to tabulating machines, where by means of a needle gas flame a tube is welded to the end of the bulb, which later provides a connection through which the lamp is exhausted. A large number of special tubulating machines are arranged on tables, and there is one operator to each machine.

At the sealing-in machines the bulbs, which have been tubulated, meet the finished stems whereon the filaments have been mounted. These machines are equipped with holders for both the bulbs and stems, which are brought together in the proper position by the operator and by mechanically rotating in an eight-flame gas blast the stem is sealed in the bulb, the joint being airtight.

The special machines which are used for creating the vacuum in the bulb are provided with two-cylinder exhaust or vacuum pumps. Each operator has two lamps on the machine at once, so that no time is lost during the process, as while one lamp is being subjected to the action of the exhaust pumps, the other is being sealed off.

The bulbs, when sealed in and exhausted, pass through the stores and inspection department for examination and counting, and then go down to the second floor for photometering. Here a force of experts test the lamps in darkened rooms to determine the rating, which is marked on the bulb in each case. From here the lamps pass to the first floor, where they meet the bases and where, by means of rotating machines in which the bulbs are placed, the bases are affixed and soldered by gas fire. One operator attends to each machine. As the circulating carrier moves around, the finished lamps are removed and new ones are inserted one by one. The lamps, now being finished, are cleaned and labeled.

Such of the lamps as are packed for immediate shipment pass over to the shipping room. Stock lamps are carried to the upper floors of the storage house and held subject to order.

A special branch of manufacture is the tungsten lamp manufacturing department, which occupies most of the second floor in the main building of the works, and is devoted entirely to the manufacture of tungsten lamps, the larger quantities of which are made in the sizes of 40, 60 and 100 watts. In the manufacture of tungsten lamps it has been the aim of the company to produce a highly efficient lamp, which should be known everywhere for quality. The operations through which the tungsten lamps pass are too numerous and varied to explain here, but it may be mentioned, in passing, that for the operation of this department a large generating station has been provided for the making of hydrogen and nitrogen gas, and close beside this station is a large holder in which these gases are stored.

In the front of the building (the north end), on the first floor, are the private offices of the general manager and the assistant general manager; also of the correspondence and general offices, as well as the telephone exchange connecting with all departments. Immediately above these offices on the second floor, and reached by means of a double stairway built

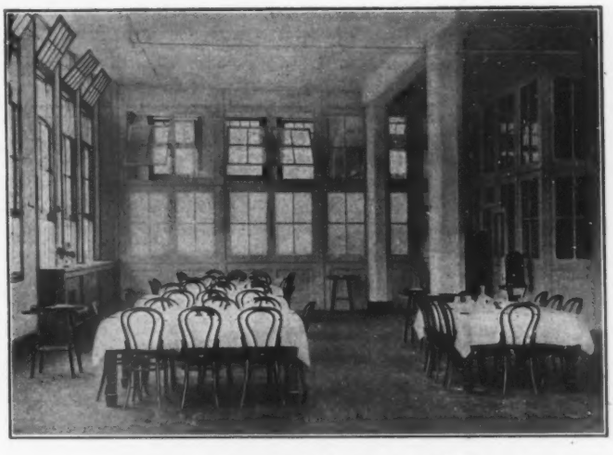


FIG. 4.—EMPLOYEES' DINING ROOM.

of concrete, are the offices of the treasurer and auditor, the engineering department and the manager of works.

On the third floor, and also in the front of the building, are the dining rooms. There is a large dining room for the office employees, the foreman and their assistants, and a private dining room for the officials of the company. Both dining rooms are directly connected with the kitchen. Two hundred employees can be comfortably fed here daily. The company provides meals to their employees at 25 cents each, which is less than the actual cost of the food served.

An organization has been voluntarily formed by the foremen and their assistants, known as the Westinghouse Foremen's

& Assistants' Association. This organization has the hearty endorsement of the management of the company and is encouraged in every way in its endeavor to foster and develop a spirit of co-operation, one with the other, in the work of the various departments. Meetings for the discussion of subjects pertaining to the interests of the company and employees are held at regular intervals, and outings are frequently held during the summer months.

In the near future it is the intention to equip, close by the works, a club, the building for which is now available. A library, reading room, shower baths, bowling alleys, billiard and pool room and other requisites of a modern social industrial club will be provided. Close by the works, on the company's property, is a baseball ground, upon which many of the employees play at noon and spare hours.

FIG. 5.—MEDICAL ROOM.

A unique feature in the organization of the Westinghouse Lamp Company is a dispensary and a rest room for the employees. A regular physician has entire charge and gives undivided attention to this work, being on hand at all times to render medical advice or assistance when needed. Every needful thing is provided for the care of an employee who may be injured while in the performance of work, and other less important ailments are attended to and the medicine furnished without charge to the employees.

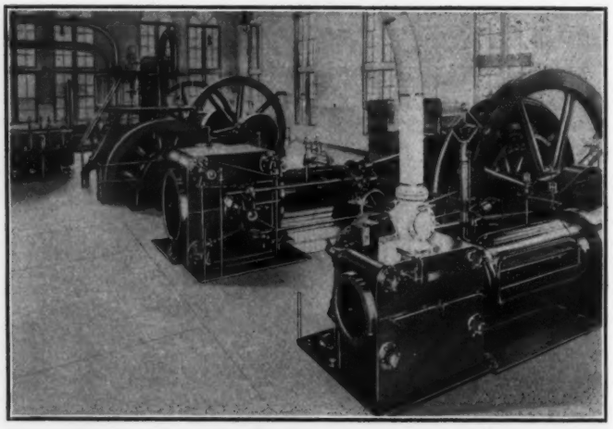
The entire work of designing and constructing the plant was done by Westinghouse, Church, Kerr & Company.

Electrical Equipment of a Steel Foundry.

What is claimed to be the largest custom foundry in the West is owned and operated by the Falk Company at Milwaukee, Wis. In this foundry, and the machine shop connected therewith, electricity and compressed air are used wherever they can be applied. The foundry is illuminated at night by means of arc lamps, while the pig iron is unloaded from cars by means of a 2-ton lifting magnet of the Cutler-Hammer type. Electricity is successfully used for welding; bars welded electrically have withstood tensile strains as great as 58,000 lb. per square inch. All of the machinery in the entire works of the company which does not use compressed air is electrically operated, principally by individual-motor drive, although short lines of shafting are used in such places as the pattern shop, cleaning department of the foundry, etc., where numbers of light running machines make this arrangement the best.

Electric energy and compressed air are supplied from a new central power station, which is one of the most interesting features of the Falk Company's works. Neatness, orderly arrangement and absence of a large percentage of the usual quantity of piping are points which strike the visitor's attention immediately upon entering. The machinery, which is of Allis-Chalmers make, consists of a cross-compound. condensing Reynolds-Corliss engine coupled to a 500-kw direct-current generator delivering energy at a terminal e.m.f. of 250 volts; a simple condensing Reynolds-Corliss engine of the vertical pattern direct connected to a 125-kw generator with characteristics similar to the larger machine; and two air compressors, one two-stage and the other single-stage, having ratings of 2500 and 1800 cubic feet of air per minute. The steam end of each unit is an engine of the same type as that driving the main generator.

Electrical energy is distributed to the shops through insulated underground cables which feed to a network of wires run in iron piping to the various departments where energy is needed.



INTERIOR OF GENERATOR AND COMPRESSOR ROOM.

One of the important departments of the plant is that devoted to the manufacture of street railway motor gears and track appliances, which department in fact was the first one established by the Falk Company.

Cartridge Jump-Spark Coil.

A new ignition coil has been put on the market by the Chicago Coil Company, 36 La Salle Street, Chicago, Ill. A feature of the coil is that any of its principal parts may be readily and rapidly replaced. In order to get to such parts as the secondary and condenser, all that is required is the removal of four screws from the vibrator end of the box. This allows the primary-winding core and vibrator to come off as a unit with the end of the box. When this is done, the secondary winding or cartridge and the condenser cartridge may be removed from the box altogether or separately and new ones slipped in, or the old ones tested or repaired with very little trouble or expense.

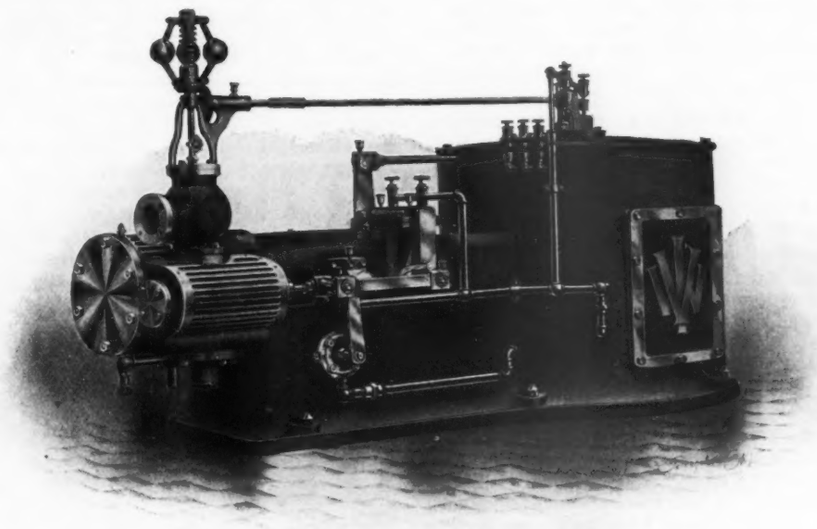
The cartridge for these coils are vacuum treated while being boiled out in wax, so that all air gases or moisture are removed and a high quality of insulating compound takes the place, hermetically sealing the coils and the condensers in their respective receptacles. The coil windings are made of black enameled wire in place of cotton or silk-insulated wire, for the reason that the enameled wire occupies a smaller space and gives a more effective winding, but principally because enamel-insulated wire is impervious to moisture gases and has a higher insulation than the other kinds of wire used in the past. The cartridge coil has an effective contact adjuster, which gives an adjustment that cannot change of its own accord, but which requires no tools to change when desired. The coils are furnished in all sizes and for all requirements.

CARTRIDGE JUMP-SPARK COIL.

Vertical-Shaft Engine.

Modern engineering developments, and particularly the increasing use of the centrifugal pump, have led to the design and manufacture of the interesting type of engine illustrated herewith, known as the Lycoming vertical-shaft engine and made by the Valley Iron Works, Williamsport, Pa. There are services to which the vertical type of pump adapts itself more readily than the horizontal type, and to drive the former for circulating water through surface condensers was the service that first led to the design of the Lycoming engine, although there are many other services which will readily suggest themselves to the engineer's mind to which a vertical-shaft engine can be put to good advantage.

In the various instances where engines have heretofore been built with vertical shafts, the two-cylinder or three-cylinder type of design has been used, having the crank at 90 deg. or 120 deg. apart, thus eliminating the trouble due to the dead center without the use of a fly-wheel, but the demand remained for a single-cylinder engine of simple design, capable of being run continuously without shutting down for oiling or any other purpose excepting at long intervals. It was to meet these requirements that the builders designed the engine illustrated.



VERTICAL-SHAFT ENGINE.

which is shown in two side elevations and in longitudinal section.

For the double purpose of presenting a neat and pleasing appearance and to admit of a liberal use of oil, the enclosed type of bed was used, the body being made oil-tight and utilized as a reservoir for the oil, which is fed to the several bearings by the pump and piping shown.

The cross-head has three bearings, the guides being of the bored type; the two guides on the sides of the bed take the thrust of the connecting rod and doing practically all of the work, while the bottom bearing maintains the cross-head in true alignment at all times. Each of the cross-head bearings is fitted with a babbitt-lined shoe, having a taper fit on the cross-head to admit of adjustment to compensate for wear; the cross-head pin has a nut fitted to the top for the purpose of withdrawing the pin, the nut also acting as a collar through which two screws are placed for holding the pin in position.

The center crank is used, first, to present a rigid resistance to the thrust of the connecting rod, thus preventing tipping of the thrust bearing and giving a practically even distribution of the load on the thrust bearing for all parts of a revolution; second, to allow of the governor wheel or eccentric—as the case may be—to be placed above the crank, where it is more accessible and convenient than if placed below; and, third, to admit of the shaft being carried upward for driving a vertical shaft above if desired; a flexible coupling is placed on the shaft for driving its connecting shaft, thus avoiding any trouble should either of them become moved out of line. The upper main bearing is carried in a spider which is tightly fitted and rigidly bolted to the bed, thus becoming practically part of the bed.

The engine illustrated is fitted with the new Gardiner traction throttling governor, which is operated by a shaft and mitre gearing instead of the usual belt, and is capable of a variation in speed of 100 per cent. The throttling governor is used in such work as pumping, where it is desirable to change the speed while the engine is running, but the engines are also built with the well-known Rites inertia centrifugal automatic governor for constant speed. Each end of the eccentric rod is fitted with a specially-designed universal connection to take care of the radial motions at right angle to each other imparted to it by the eccentric and rocker arm.

The question that will interest engineers mostly in considering this new departure in the line of engine building is the form of thrust bearing that will be found to work satisfactorily in carrying the weight of the balance wheel and other revolving parts. For the smaller sizes—up to 50 hp—a bearing consisting of a fiber disk has been found to give excellent service, while for the larger sizes a roller bearing, or combination of rollers and balls, is used; the marine thrust bearing has also been adapted to the engine and it is believed will give good results.

A number of ingenious devices are used for distributing the oil to the various moving parts of the engine, such as the guides, cross-head pin, eccentric, etc. The oil to the crank pin is conveyed through the center of the shaft, a hole being drilled for the purpose. To prevent oil from the main bearing and thrust bearing following down the shaft, an oil catcher has been placed in the main pedestal below the bearing, the pedestal being cored out for the purpose. This catcher surrounds the shaft, but is fastened to the bed; an oil collar fitting the shaft tight and placed directly above this catcher throws all oil into the catcher, from which a pipe conveys it back into the bed and thence again through the circulating pump.

Access to the cross-head and guides is had through an opening in the top of the bed below the rocker arm; to the lower main bearing and crank pin through the opening in the sides of the bed shown, and to the eccentric and upper main bearing through a similar opening in the top of the cover. These openings are covered by plates easily removed; the plate on the side of the bed has a small trap door, normally kept closed by a spring, through which a bar can be inserted for the purpose of moving the engine off the dead center.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

During the past week there has seemed to be a distinctly better feeling in commercial lines, although the volume of trade at present is still far below normal for this season of the year. The near approach of the election is doing something to retard activity, as many conservative business men prefer to wait until the excitement is over before making new outlays. For this reason buying is mainly for quick delivery, small orders being hurried to retailers to fill immediate needs. Retail business is better in the West and in the agricultural sections, where money is generally more plentiful in the hands of the people. The long idleness of many operatives in industrial sections has to a considerable extent curtailed the buying power. In some sections of the West the protracted heat has prevented seasonable fall buying, but in spite of this it is generally admitted that retail stocks are exceptionally light, this view of conditions being further borne out by a number of filling-in orders which daily reach the jobbers. The heat and lack of rain in the West, while favorable to the maturing of the corn crop, have done much damage in some other lines. The hay and fodder crop is not large, and, probably more serious than anything else, the shortage of fall grazing has caused heavy inroads into the stock of winter food. Collections in the agricultural sections as a rule are normal, being helped by the active marketing of crops at good prices. In the industrial centers the revival of activities is not conspicuous, except among the lumber mills of the South and the Pacific Northwest. The iron and steel industries are improving very slowly, and the demand for electrical machinery is lighter than it has been for the past two months. The railroads are doing much better, though far below last year, and the number of idle cars is being rapidly reduced. This is due in a great measure to the early and free movement of the crops. Prices as a rule for all manufactured articles are at a considerably lower level than last year, the direct effect, of course, of the effort to stimulate the apathetic demand. Export trade has been no better than domestic, but the balance remains largely in favor of this country, as the decrease in the ratio of imports has been far greater than in shipments. It was claimed last week, among the importing houses, that there was a marked improvement in the diamond trade. This is encouraging, as the diamond business is essentially one of prosperous times. A canvass of the dry goods retailers and jobbers, by a trade publication devoted to that interest, has resulted in a distinctly encouraging note, practically all of the leaders expressing the utmost confidence in the future. The consensus of opinion is that, as soon as the presidential election is over and there is no longer any alarm over a disturbance of the present tariff schedule, buying orders will come in upon the wholesalers more rapidly than they can be attended to, and that these will be made necessary because the retailer will have a more insistent demand for goods than he has ever known. Mr. John Wanamaker expresses a typical view of the condition when he says: "Likening the business interests to a convalescent patient, business has begun to 'sit up,' and is showing an appetite for the old things formerly enjoyed. Every kind of store feels the effect of this, and everybody has to lay in supplies, and a healthy business has already set in. We are getting ready for larger business in Philadelphia by tearing down our old buildings and completing our 14-story granite building. Our New York salesrooms show a finely increased demand for almost everything we sell." The money market continues easy, with demand only slightly improved and bank clearances for the week ended Sept. 24 were 8.6 per cent higher than they were last year. Business failures for the same week, according to *Bradstreet's*, were 267, against 266 the previous week, 166 in like week in 1907, 165 in 1906, 185 in 1905, and 179 in 1904.

THE COPPER MARKET.

The copper market for the week which ended Sept. 28 was dull and practically featureless. Its close relation to copper securities in Wall Street shows that metal prices are controlled more by the managers of stock manipulations than by the laws of supply and demand. When the stock market was heavy and Amalgamated was below 70 copper was marked down until Electrolytic could be bought at 13 cents; when the stock market recovered copper recovered from ¼ to ⅜ of a cent. Neither when it was down nor when it recovered was any buying sentiment developed. Very few orders were received either from consumers or from dealers. In fact, the copper sold for consumption during September will probably be much less than that of either of the two preceding months, and the exports will certainly be below the normal figures. There has been nothing of importance to note in the export movement, which has been of the same character as during the preceding months of the year, and from present indications the total shipments to Europe during September will be about 20,000 tons. Imports have continued to increase steadily, and are now estimated at about 10,000 tons for the month. Fortunately, the market seems to be still in strong hands, and there is no pressure to sell. The ease with which the price was marked up after stocks began to react, entirely independent of the fact that there was no demand for metal to cause an advance indicates that the market can be placed and held in any position that suits the great producing interests. These men and those who affiliate with them seem perfectly satisfied. This optimism is, of course, the offspring of confidence in the strength of the controllers of the market in this country and in Europe, not of a study of actual conditions. The production of copper goes on with unabated vigor. It is estimated that the Lake Superior region for the first eight months of the year turned out 148,879,834 lb., which is less than 3 per cent less than the production for the same period last year. The figures are merely typical of the production of other regions. Exports so far for September have been 18,336 tons. Prices on Sept. 28 quoted on the Metal Exchange were:

Lake	13⅜ @ 13½
Electrolytic	13⅜ @ 13¼
Castings	12⅞ @ 13⅛

The London market was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	59 18 9	59 15 0
Standard copper, futures	60 15 0	60 10 0
Market	Easy.	Easy.
Sales of spot		300 tons
Sales of futures		700 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅝
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 5 0
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	60 0 0

THE NEBRASKA POWER COMPANY.—A certificate of incorporation was granted to the Nebraska Power Company by the State of Delaware on September 26, 1908. The capitalization of the company is fixed at $12,000,000. The purposes are to construct, acquire, own and operate hydro-electric power plants, together with everything whatsoever pertaining thereto. The incorporators of the company are H. E. Babcock, Columbus, Neb.; W. J. McEathron, Omaha, Neb., and Harry W. Davis, Wilmington, Del. The Corporation Trust Company of America, New York, is named as the agent in charge of the principal office of the company in Delaware.

TO INVESTIGATE ECONOMIC POWER COMPANY.—The Public Service Commission of the Second District of New York has issued an order directing the Economic Power & Construction Company, of Buffalo, to produce before the commission all of its books and papers. The company had refused to file a report with the commission, claiming that it was out of its jurisdiction. The corporation has a special charter from the Legislature enabling it to operate anywhere in the State, supplying heat, light and power without regard to the local authorities.

LARGE IRRIGATION PROJECTS.—J. G. White & Company, Inc., engineers and contractors, 43-49 Exchange Place,

New York, have begun the surveys for Mr. F. H. Buhl, of Sharon, Pa., on one of the largest irrigation projects ever undertaken, contemplating the reclamation of about 700,000 acres of arid land in southern Idaho. The project is practically an extension of the noted Twin Falls development. Water supply for the proposed extension will be obtained from Snake River. The lands lie to the west of the Twin Falls tract beyond Salmon River and in part beyond Bruneau River. The surveys in progress include reservoir sites, the enlargement of the present Twin Falls Canal, which was developed by Mr. Buhl, to a capacity sufficient to carry the increased water sup ply, an extension of the main canals to cover the lands of the project including a siphon to carry the water supply across Salmon River Canyon, which is about 1650 ft. wide and whose bed is 500 ft. below the level of the proposed canal. Five surveying parties are already in the field at work on the various parts of the project. J. G. White & Company has also in hand a project for the Idaho Irrigation Company to furnish an irrigation scheme for 180,000 acres in southern Idaho.

GENERAL ELECTRIC TO GET BIG BRAZILIAN CONTRACT.—The General Electric Company has secured the contract for supplying the apparatus necessary for the electrification of 17 miles of the Central Railway of Brazil in the immediate neighborhood of Rio de Janeiro. This contract has been made with Guinle & Company, the Brazilian representatives of the General Electric Company. The Central Railway of Brazil is the largest enterprise of that character in the country and is a government institution. The present contract with Guinle & Company will become operative just as soon as the Brazilian Congress has made the proper appropriation. The details of the contract have been agreed upon. The value of the property of the Central Railway is estimated at $70,000,000, and it is proposed to install four tracks in the suburban portions. There are about 700 miles of track in the entire system, with 303 locomotives and about 3000 cars. Two lines will be electrified at once, and all the depots will be provided with electrical illumination. Guinle & Company as the Brazilian representatives of the General Electric have secured the contracts both for the electrical machinery and through its hydro-electric plant to supply the power, light and heat for the operation of the service. The plant is situated on the Piabanha River at its falls in the mountains, 40 miles or more from Rio de Janeiro, and Guinle & Company have received all the necessary concessions from the Brazilian government. A dam of 110 m. in length has already been constructed, and in a short time the company will be able to deliver power from this plant. Other dams will be built later on and the extent of the company elaborated. Eventually it is expected that 50,000 hp can be delivered. The present power house is equipped with three horizontal type Francis turbines of 5150 hp, each built by J. M. Voith, of Germany, directly-connected with 3000-kw, 514-r.p.m., 2300-volt General Electric generators. The exciters of 75 kw are driven by two 130-hp turbines directly-connected. The voltage is raised from 2300 to 44,000 by means of nine oil- and water-cooled transformers of 1000 kw each. The transmission system consists of two three-phase, 60-cycle, 44,000-volt transmission lines, with a capacity of 5250 kw each. These lines are carried on 50-ft. galvanized steel towers placed 200 m apart. At Cascatinha, about 18 miles from the power house, there is a switching station and the transmission lines divide, one going to Rio de Janeiro and the other to Nictheroy, on the opposite side of the bay. The company has in addition to its railroad contract large opportunities to sell both light and power in the two cities. The firm of Guinle & Company has also been granted a federal concession covering the supply of light and power to the city of Sao Paulo, a place of 300,000 inhabitants and the largest coffee market in the world. In this project a hydro-electric plant will be constructed on the Stapanhau River at the falls, 45 miles from the city. The apparatus will be furnished by the General Electric Company.

RUSH WIREDUCT SHIPMENTS.—The H. B. Camp Company, in order to rush an order to the Atlantic coast, employed a special train of 16 cars to transport 100,000 ft. of wireduct from its plant at Aultman, Ohio. As soon as the train reached New York the piping was loaded into the hold of a special steamship and was hurried to South America. The order is for the United River Plate Telephone Company, operating under the Bell system in Argentina, and is for the installation at Bahia Blanca, a port of 45,000 inhabitants, 400 miles south of Buenos Ayres.

Financial Intelligence.

THE WEEK IN WALL STREET.

Last week was one of violent fluctuations in the stock market. From the low point at the close of the market Sept. 22 to the high point of the week, which was in most cases on Sept. 25, there were for many stocks as much as 10 points change. After sagging and drooping for several days there was a sharp break Sept. 22 and a rush to sell that was more like excitement than anything occurring in the market for months. The next morning, when further weakness might have been anticipated, the feeling in the market was perfectly placid, and after a few moments of uncertainty a strong buying sentiment developed and prices were buoyant all day. All of which goes to show that the market is still in perfect control of strong hands and that the available supplies of stock are so limited that very little buying is sufficient to sustain quotations. After the recovery had almost reached the former levels trading settled down to the same old humdrum that has characterized it for three months. Now the question is naturally of interest to Wall Street and the point upon which there is no direct information, is whether or not the big decline was the result of profit taking by the powerful sides or of a political scare or the selling of small speculators who have been trailing. If the latter explanation is correct it is evident that the men behind the upward move made no effort to support prices and permitted the sellers to have full possession of the field. The weight of opinion seems to be that big interests in reality let go large quantities of their stock at the higher figures—stock that they accumulated in the spring and early summer at much lower prices—and then when the selling movement was in full swing bought back their shares at declines of from 5 to 10 points. The volume of the trading

NEW YORK.

	Sept. 21.	Sept. 28.	Shares Sold.		Sept. 21.	Sept. 28.	Shares Sold.
All.-Ch.	10¼	10¼	1,400	Int.-Met., pfd..	30	32	10,525
All.-Ch., pfd....	30½*	31⅜	1,300	Mackay Cos....	68⅛*	68	100
Amal. Cop.	71¼	73	254,525	Mackay Cos.,pfd.	69*	68*	642
Am. D. T.....	35*	35*	——	Manhattan Elev.	133¼	136	376
Am. Loc.	45	46¾	28,125	Met. St. Ry....	30*	30*	10
Am. Loc., pfd..	100¾	101⅛	1,700	N.Y.&N.J. Tel..	115½	116	100
Am. Tel. & Cbl.	68	70*	103	Steel, com.	43¼	44¾	603,535
Am. T. & T....	126¾	129	12,400	Steel, pfd.....	107¾	108⅛	42,300
B. R. T.....	47⅜	47¼	32,170	W. U. T.....	57⅜	61⅛	4,628
Gen. Elec.	138	139	2,300	West'h, com. ...	71	74	13,320
Int.-Met., com..	10¾	10⅞	4,900	West'h, pfd....	88½	88	300

PHILADELPHIA.

	Sept. 21.	Sept. 28.	Shares Sold.		Sept. 21.	Sept. 28.	Shares Sold.
Am. Rys.	44¼	44¾	——	Phila. Elec. ...	9¾	9¼	——
Elec. Co. of A..	10⅛*	9⅞	——	Phila. R. T....	17½	19¾	——
Elec. Stor. B'ty	35¼	35½	——	Phila. Traction.	88¼	88	——
E. S. B'ty, pfd.	49*	49*	——				

CHICAGO.

	Sept. 21.	Sept. 28.	Shares Sold.		Sept. 21.	Sept. 28.	Shares Sold.
Chi. City Ry...	176½*	176½*	——	Met. El., com..	13¼	13¼*	——
Com. Edison ..	106½	106¼	——	Nat'nal Carbon.	70	70*	——
Chi. Subway ...	20½*	19	——	Nat. Carb., pfd.	109¼	108	——
Chi. Tel. Co....	146	146	——				

BOSTON.

	Sept. 21.	Sept. 28.	Shares Sold.		Sept. 21.	Sept. 28.	Shares Sold.
Am. Tel. & Tel.	127	129	——	Mass. E. R.,pfd.	49	52	——
Comb'ind Tel...	125*	125*	——	Mex. Tel., pfd..	6*	6	——
Gen. Elec.	139¾	139	——	N. E. Tel'p....	118½	119¾	——
Edison El. Ill..	230	230*	——	W. Tel. & Tel.	7½*	8	——
Mass. Elec. Ry.	9¼	10¼	——	W. T. &2T., pfd.	80*	80	——

*Last price quoted.
Shares sold are for week Sept. 21 to Sept. 26.

indicates that this theory is correct. For several days there were sales of more than a million shares, an amount of trading that could hardly have been accomplished unless large holders had been in the game. Stocks came out in 500 and 1,000 share lots, which of itself indicated that the "little fellows" were not doing all the selling. On one point there seems to be a unanimous opinion at this time, and that is, that if the strong interests behind the market gathered in their profits before and in the early stages of the break, they have loaded up again, and the professionals have as strong a hand on the rein now as they had before any reaction occurred. That there was something of a political scare, too, there is no doubt. The general apathy of the Republicans was brought pointedly to the attention of the street by such shrewd observers as J. J. Hill and Mr. Harriman, and politics, which had been generally a matter of indifference, suddenly became of absorbing interest. With all the ups and downs of prices and the market in the hands of the manipulators, conditions remain the same. The

return of business to normal conditions is tediously slow, much too slow, in fact, to warrant such prices as prevailed at the high points and such prices as prevail now after the recovery from the selling paroxysm. It is true that the number of idle cars has been decreased 50,562, indicating that more railroad business is being done, but earning reports are still discouraging. The action of the Exchange in expelling two members who were held responsible for the shameless thimble rigging and fake selling on that August day when a bear raid was attempted should have a salutary effect. It indicates at least an honest attempt to protect the public from false prices created by bogus transactions. In spite of some call for money from the interior, the accumulations in the New York banks is almost oppressively large, and during the week call loans fell to the low quotations of the year. On Sept. 28 the rates were, call 1@1½ per cent, 2¾@3 per cent for 90 days. The prices quoted in the table are those of the close Sept 28.

DIVIDENDS.

United Railways Company, of St. Louis, preferred, quarterly, 1¼ per cent, payable Oct. 10.

Chicago Telephone Company, quarterly, 2 per cent, payable Dec. 31. Stock dividend, 20 per cent, payable Oct. 10.

Rochester Railway Company, preferred, quarterly, 1¼ per cent, payable Oct. 1.

Cincinnati & Suburban Bell Telephone Company, quarterly, 2 per cent, payable Oct. 1.

Cincinnati Gas & Electric Company, quarterly, 4⅛ per cent, payable Oct. 1.

Cincinnati Street Railway Company, quarterly, 1½ per cent, payable Oct. 1.

Springfield (Ill.) Railway & Light Company, quarterly, 1 per cent, payable Oct. 1.

Railway Steel Spring Company, 1 per cent, payable Oct. 22.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable Oct. 9.

Mexican Telegraph Company, quarterly, 2½ per cent, payable Oct. 10.

Boston Suburban Electric Companies, preferred, $3 per share, payable in quarterly instalments of 75 cents, beginning Oct. 15.

Philadelphia Company (Pittsburg), common, quarterly, 1½ per cent, payable Nov. 2.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable Oct. 1.

Gamewell Fire Alarm & Telegraph Company, quarterly, 1¼ per cent, payable Oct. 1.

New York & New Jersey Telephone Company, quarterly, 1¾ per cent, payable Oct. 15.

Electric Storage Battery Company, quarterly, ¾ per cent, payable Oct. 1.

Capital Traction Company, Washington, D. C., quarterly, 1½ per cent, payable Oct. 1.

Columbus (Ohio), Newark & Zanesville Electric Railway Company, preferred, 1½ per cent, payable Oct. 1.

Louisville & Northern Railway & Light Company, quarterly, on class A stock 1½ per cent, on class B 1 per cent, payable Oct. 1.

Aurora, Elgin & Chicago Railway Company, preferred, quarterly, 1¼ per cent; common, quarterly, ¾ per cent, payable Oct. 10.

Omaha & Council Bluffs Street Railway Company, preferred, quarterly, 1¼ per cent, payable Oct. 1.

Scioto Valley Traction Company, Columbus, Ohio, preferred, quarterly, 1¼ per cent, payable Oct. 1.

Syracuse (N. Y.) Rapid Transit Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Michigan Light Company, preferred, quarterly, 1½ per cent; common, quarterly, 1 per cent, payable Oct. 1.

United States Smelting & Refining Company, preferred, quarterly, 1¾ per cent; common, quarterly, 1 per cent, payable Oct. 15.

Bell Telephone Company of Pennsylvania, quarterly, 1½ per cent, payable Oct. 15.

J. G. White & Company, New York, preferred, quarterly, 1½ per cent, payable Oct. 1.

Houghton County (Mich.) Street Railway Company, preferred, semi-annual, 3 per cent, payable Oct. 1.

WESTINGHOUSE REORGANIZATION PLAN ADOPTED.—At a meeting of the Readjustment Committee of the Westinghouse Electric & Manufacturing Company Sept. 24 it was practically agreed to adopt the Merchandise Creditors' plan. Some modifications in the original proposals were made, but the main features for rehabilitating the company remain. The Readjustment Committee made the following official announcement of its action: "The Readjustment Committee of the Westinghouse Electric & Manufacturing Company, of which Mr. James N. Jarvie is chairman, has adopted substantially the so-called Merchandise Creditors' Plan, notwithstanding the fact that the cash subscriptions to the new assenting stock of $6,000,000 contemplated in such plan do not at this time exceed $4,500,000, and although the assent of a considerable amount of the bank debt and a portion of the merchandise debt still remain to be secured. This substitute or modified plan was adopted, however, with the distinct understanding that the plan will not be declared operative unless the full $6,000,000 of cash subscriptions and the assents of the bank creditors are in hand by Oct. 27, 1908." This action on the part of the committee practically amounts to an extension of time until Oct. 27, for the soliciting committees to secure the missing subscriptions. The $4,000,000 in assenting stock which the merchandise creditors were required to take has been practically all subscribed, but the stockholders' subscriptions, as stated above, are $1,500,000 short, and the bank debt, which amounted to practically $8,000,000, has not been more than half provided for. It is confidently expected, however, that within the next month enough bank creditors will agree to the plan and enough stockholders will come in with subscriptions to assure the success of the plan and secure, if necessary, a further extension of time. As a matter of fact, very little progress was made in securing subscriptions during the summer. The statement given out by the Readjustment Committee early in July seemed to indicate that there was only a trifling amount to be secured, and this made the stockholders indifferent. From now until Oct. 27 active work will be done by all of the soliciting committees, and it is confidently expected that the property will be out of the receivers' hands before the first of the year. The company when the reorganization plan is completed will have in the neighborhood of $12,000,000 in cash, and its total quick assets will run close to $33,000,000.

BUFFALO CATARACT POWER BONDS.—Mr. Chas. R. Huntley, general manager of the Cataract Power & Conduit Company, Buffalo, says that over half of the bonds recently authorized by the Public Service Commission to the amount of $120,000, will be used in making the following improvements to the company's properties in the city of Buffalo: Three cables, bimetallic, steel center with copper insulation, to operate in conjunction with present 9-wire cables crossing the Niagara River; three 3000-kw transformers to step-down electrical energy from 22,000 volts to 11,000 volts; four 300-ampere, 35,000-volt motor-operated circuit breakers, two for the incoming line and two for the primary side of the transformers; two 800-ampere, 15,000-volt motor-operator circuit-breakers for the secondary side of the transformers; eight 300 amp, 15,000-volt, motor-operated circuit-breakers for the outgoing feeders; two 15,000-volt circuit-breakers to work on new cable to be installed; two 15,000-volt circuit-breakers for new panel equipments; 12 300-amp, 2200-volt circuit-breakers to replace same number of switches, which are not heavy enough for present service; one 11,000-volt bank primary panel; one 2200-volt secondary panel; 14,850 ft. 3-0, 3-conductor cable between terminals A and B; 2200 ft., 3-0, 3-conductor cable between terminal B, Ferry and Niagara Street station.

LONGACRE COMPANY ATTACKS PUBLIC SERVICE COMMISSION.—The Longacre Electric Light & Power Company, of New York City, has filed an application for a rehearing on its petition for permission to issue $10,000,000 of new preferred stock and $50,000,000 in mortgage bonds, recently denied by the Public Service Commission of the First District. The purpose for which the new capital is desired, the petition states, is to build a plant of sufficient size to furnish electric light to the theater district. The petition was denied on the ground that a new lighting company was not needed in the district. In the application for the rehearing the attorneys for the Longacre company say that the decision of the commission is void because the act creating it is unconstitutional. The validity of the law is attacked because it embraces more than one subject and its title is not sufficiently descriptive. It is further asserted by the attorneys of the complainants that the commission is authorized to deprive a citizen of his property without due process of law, which is in violation of the constitution. The commission referred the petition to its attorneys.

REPORTS OF EARNINGS OF ELECTRICAL COMPANIES.

	Gross Earnings.	Operating Expenses.	Net Earnings.	Charges.	Surplus.
Minneapolis General Electric Company:					
July, 1908	$73,889	$32,025	$41,863	$32,400	$9,463
July, 1907	67,892	30,402	37,490	26,824	10,666
Lowell (Mass.) Electric Light Corporation:					
July, 1908	25,315	15,116	10,199	3,621	6,577
July, 1907	22,397	13,061	9,335	3,082	6,253
Northern Texas Electric Company (Fort Worth):					
July, 1908	98,983	58,786	40,196	18,033	22,163
July, 1907	96,933	51,707	45,226	13,501	13,501
Seattle (Wash.) Electric Company:					
July, 1908	366,481	209,950	156,531	87,515	69,016
July, 1907	369,133	211,933	157,200	72,715	84,485
Galveston-Houston (Tex.) Electric Company:					
July, 1908	93,375	52,005	41,370	17,477	23,893
July, 1907	98,768	53,105	45,662	16,085	29,576
Houghton County (Mich.) Street Railway Company:					
July, 1908	26,300	12,713	13,587	4,635	8,953
July, 1907	26,330	12,296	14,034	4,822	9,212
Puget Sound Electric Railway Company, Tacoma, Wash.:					
July, 1908	158,336	99,615	58,720	39,741	18,779
July, 1907	171,146	96,467	74,780	34,627	40,053
Jacksonville (Fla.) Electric Company:					
July, 1908	35,559	20,691	14,868	8,324	6,544
July, 1907	34,537	19,350	15,157	6,287	8,871
Tampa (Fla.) Electric Company:					
July, 1908	45,192	32,463	12,729	2,426	10,302
July, 1907	42,515	33,093	9,422	1,308	8,113
El Paso (Tex.) Electric Company:					
July, 1908	40,821	29,352	11,469	7,209	4,260
July, 1907	41,637	31,339	10,298	5,769	4,529
Brockton & Plymouth (Mass.) Street Railway Company:					
July, 1908	15,956	9,278	6,678	2,274	4,403
July, 1907	17,452	7,918	9,533	2,170	7,363
Whatcom County (Wash.) Railway & Light Company:					
July, 1908	29,123	17,196	11,927	8,166	3,761
July, 1907	30,394	17,404	12,990	7,585	5,404
Savannah (Ga.) Electric Company:					
July, 1908	53,455	32,764	20,690	15,840	4,850
July, 1907	55,452	33,601	21,851	15,024	6,826
Fonda, Johnstown & Gloversville (N. Y.) Railroad Company:					
August, 1908	83,200	34,376	48,824	.....	.....
August, 1907	94,278	42,520	51,758	.....	.....
Northern Ohio Traction & Light Company (Akron, Ohio):					
August, 1908	209,741	107,356	102,385	43,381	59,004
August, 1907	216,145	112,860	103,285	43,522	59,763
Northwestern Elevated Railway Company, Chicago:					
Year ended June 30, 1908	2,463,188	965,118	1,498,070	1,147,183	350,887
Year ended June 30, 1907	2,100,315	744,304	1,356,011	1,008,433	347,578
Toledo (Ohio) Railways & Light Company:					
August, 1908	212,318	113,811	98,449	71,879	26,706
August, 1907	221,261	118,524	102,737	68,668	34,930
Central & South American Telegraph Company:					
July 1 to Sept. 30, 1908 (estimated)	365,000	165,000	200,000	143,565	60,935
July 1 to Sept. 30, 1907	405,000	147,500	257,500	145,048	117,451
Lake Superior Corporation:					
Year ended June 30, 1908	566,616	63,522	.....	475,225	27,869
Year ended June 30, 1907	678,011	148,381	.....	500,000	29,630
Birmingham (Ala.) Railway, Light & Power Company:					
August, 1908	172,532	119,455	53,076	43,785	9,291
August, 1907	185,770	122,787	62,982	40,750	22,232
Nashville (Tenn.) Railway & Light Company:					
August, 1908	127,795	78,166	49,629	32,811	12,988
August, 1907	131,196	80,342	50,853	31,370	16,983
South Side Elevated Railroad Company, Chicago:					
Year ended June 30, 1908	2,242,345	1,569,231	673,114	377,684	295,430
Year ended June 30, 1907	1,854,049	1,292,009	562,040	33,750	528,290
Metropolitan West Side Railway Company, Chicago:					
Year ended June 30, 1908	2,809,483	1,457,152	1,352,341	1,070,780	286,577
Year ended June 30, 1907	2,878,587	1,443,498	1,435,089	1,050,123	291,785
Twin City Rapid Transit Company, Minneapolis:					
August, 1908	592,702	281,707	310,995	128,667	182,328
August, 1907	558,226	260,782	297,444	115,142	182,302
Memphis (Tenn.) Street Railway Company:					
August, 1908	141,191	87,929	53,262	35,532	15,230
August, 1907	144,514	85,781	58,733	34,447	21,786
Westinghouse Air Brake Company:					
Year ended July 31, 1908	5,308,016	3,293,260	2,014,756	43,960	1,970,769
Year ended July 31, 1907	11,230,409	6,985,337	4,245,072	393,242	3,851,839

GENERAL NEWS

Construction News.

CORDOVA, ALASKA.—H. Brotnalier, of Tacoma, Wash., will install a light, water and telephone system in Cordova, Alaska, at an estimated cost of $500,000.

ENSLEY, ALA.—The United States Steel Corporation has authorized extensive improvements made to the plant of the Tennessee Coal & Coke Company at Ensley, Ala., which will involve an expenditure of about $2,000,000. Among the improvements contemplated is the erection of an electrical repair shop and the installation of additional electrical machinery. G. G. Crawford is general manager.

GANTTS QUARRY, ALA.—Arrangements are being made by the Alabama White Marble Company to increase the output of its power plant, which will involve an expenditure of about $150,000, and include the installation of a 300-hp engine, two 300-hp boilers, dynamo, air compressor, 20-hp engine and other equipment. John Stephen Sewell is in charge of the work.

LIVINGSTON, ALA.—It is reported that a company will be formed to install an electric light plant to supply 500 lamps. C. H. Brooks, of Cuba, Ala., is engineer.

NOME, ALASKA.—J. A. Darlington, a representative of the General Electric Company, has been in conference recently with George L. Leland in regard to the feasibility of establishing a power plant at Salmon Lake. It is proposed to build a 25,000 hp plant at a place where the Kruzejamepa River forms an outlet for Salmon Lake. The power will be generated by a dam, and the electric current would be distributed among the dredges which are taking the gravel from the creeks in that vicinity.

MAGAZINE, ARK.—The Magazine Gin & Grist Company is planning to install an electric lighting system to be operated in connection with its mill.

OAKLAND, CAL.—Work has commenced on the construction of the large auxiliary steam power plant of the Western Power Company, which is to be located on Sessions Basin, near the foot of Seventh Street. The cost of the plant is estimated at $2,000,000 and will have an output of 24,000 kw, and will be used in conjunction with the plant at South Bend, Cal. H. P. Wilson, of New York, N. Y., is vice-president of the company.

PASADENA, CAL.—The Pacific Electric Railway Company has been granted a franchise to construct an electric railway on East California Street to Tournament Park. The price paid for the franchise was $100.

QUINCY, CAL.—Q. C. Pratt and C. G. Zaschockelt have applied to the Board of Supervisors for a franchise to erect transmission lines along Indian Valley and in the streets and public highways in the town of Greenville for the distribution of electricity for lamps and motors.

RIVERSIDE, CAL.—The City Council has granted the Riverside & Arlington Railway Company permission to construct an electric railway in Riverside.

SACRAMENTO, CAL.—The Great Western Power Company has applied to the Board of Trustees for a franchise to erect transmission lines for the distribution of electricity for industrial purposes in Sacramento.

WILLOWS, CAL.—The Glenn County Telephone Company has been granted a franchise to erect telephone lines and operate a complete telephone system in Willows.

BETHEL, CONN.—The contract for lighting the streets of the borough with electricity has been awarded to the Danbury Gas & Electric Company. The contract is for a term of two years, dating from Jan. 1, 1909. The company is extending its transmission lines to Bethel to furnish electricity for lamps and motors.

KILLINGLY, CONN.—Plans are being prepared by the Nashawaug Electric Power Company to erect a power plant at Daniel's Mills, in the upper part of Killingly, where it proposes to develop 300 hp, at a cost of about $55,000. The company has also purchased the Sabin Sayles water power privilege, located between Dayville and Attawaugan, which will be held for future development. The company will furnish electricity to operate the mills of the Attawaugan Company and to light the upper part of the town. The company was incorporated in 1893, with a capital stock of $300,000. The officers are: Grosvenor Ely, president; Norris Lippitt, vice-president; Frank B. Perry, secretary, and Frederick W. Smith, of Pawtucket, R. I., treasurer.

MIDDLETOWN, CONN.—The Middletown Electric Light Company has made a reduction in its prices of electricity for lamps and motors, the new schedule to take effect from Sept. 1, as follows: Electricity for lamps has been reduced from 18 to 16 cents per kw-hour, with the usual discounts. Electrical energy for motors has been reduced from six to two cents per kw-hour, where formerly it was 10 cents per kw-hour. The discounts on lighting bills are as follows: On all bills from $1 to $16, a discount of 5 per cent is allowed; from $16 to $32, 10 per cent; from $32 to $48, 20 per cent; from $64 and upward, 25 per cent. L. C. Whitney is manager.

NORWICH, CONN.—The large dam of the Uncas Power Company at Scotland, Conn., is nearly completed, and is expected to be placed in commission within two weeks. The power plant and the transmission line from the power house to Norwich, a distance of 10 miles, have been completed and are ready for operation. The plant will furnish electricity for the municipal electric plant in Norwich.

LAUREL, DEL.—Wallace Stebbins & Sons, of Baltimore, Md., have been awarded the contract for equipment for the municipal electric light plant, for $11,766. The contract for enlarging and repairing the power house was awarded to C. W. Donaldson, of Laurel, Del.

WASHINGTON, D. C.—The Capital Traction Company has awarded a contract for the construction of its new substation at First and B Streets Southwest to James L. Parson, the cost of which is estimated at $30,000.

WASHINGTON, D. C.—Bids will be received until Oct. 6, by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards and naval stations the following supplies; New Orleans, La., Schedule 358—20 arc lamps and 200 carbons; electric fixtures, etc., 135 street hoods, 16 reflector pole tops and six mast arms, 150 cypress cross arms, electric fixtures for dispensary building, etc.; Schedule 359—3,000 lin. ft. round duct conduit. Also until Oct. 13, at Mare Island, Cal., Schedule 332—motor-driven lathe; also until Oct 20, at Mare Island, Cal., Schedule 339—motor-driven floor grinder, etc. E. B. Rogers is paymaster general, U. S. N.

LAVONIA, GA.—Plans are being considered to establish a lighting and power plant in Lavonia. It is proposed to organize a company with a capital stock of $15,000 to build the plant.

ST. ANTHONY, IDAHO.—J. M. De Costa has located a power site on the Teton River and is promoting a large electrical power proposition in Fremont County. The site is about 22 miles east of St. Anthony, where at low water the river, it is estimated, will furnish 14,100 hp.

CHANDLERVILLE, ILL.—Bids opened Sept. 17 for equipment of an electric light plant, including a 75-hp gas producer and engine, or a 50-hp steam engine, were all rejected by the Village Board.

CHICAGO, ILL.—Bids will be received by William Carroll, city electrician, Room 403, 76 Fifth Avenue, Chicago, Ill., until Oct. 1, for furnishing and installing complete electrical equipment in two city substations in accordance with plans and specifications on file in the office of the city electrician; also for 4000 alternating-current series arc lamps; seven 60-cycle, single-phase, 250-kw step-down transformers; 35 60-cycle, single-phase, 1-kw step-down transformers; 90 50-light induction regulators.

HAVANA, ILL.—The City Council is reported to be considering the question of establishing a municipal electric light plant. The franchise held by the Havana Electric Company has not yet expired.

PEORIA, ILL.—The Chicago, Ottawa & Peoria Railway Company has filed a mortgage with the Central Trust Company of Illinois, as trustee, to secure an issue of $5,000,000 in bonds, guaranteed by the Western Railways & Light Company. The company is to build an electric railway between Peoria and Chicago, and is already operating between Princeton and Seneca, Ill., a distance of 58 miles. Work has commenced on the construction of a 16-mile branch from Ottawa to Streator.

FARMLAND, IND.—The Indiana Union Traction Company, of Anderson, Ind., is making investigations with a view of extending its transmission line to furnish electricity for lighting in Farmland.

MARION, IND.—Bids will be received at the office of the city clerk until Oct. 13 for the construction of the addition to the municipal electric light plant. Plans and specifications and other necessary data will be furnished to bidders upon receipt of $3 for blue prints and $3.50 for plans and specifications. John O. Wilson is clerk of Board of Public Works.

DANBURY, IA.—The citizens on Sept. 8 voted to issue $7,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant.

HARTLEY, IA.—Contracts have been awarded for equipment for the municipal electric light plant as follows: To the Minneapolis Steel & Machinery Company, of Minneapolis, Minn., for gas engine and producer plant, for $5,200; Westinghouse generator and switchboard, to C. V. Jones, of Fort Dodge, Ia., and for pole lines, lamps, etc., to the Electric Construction Company, of Sioux Falls, S. D. E. B. Rich, of Fort Dodge, Ia., is electrical engineer.

LAKE CITY, IA.—The stockholders of the Des Moines, Sioux City Railroad Company have voted to increase the capital stock of the company from $20,000 to $1,000,000. The company proposes to construct an electric railway from Des Moines to Sioux City, 192 miles in length, work on which has already commenced. M. H. Miller is vice-president and general manager.

MUSCATINE, IA.—The Independent Power Company, recently organized, is planning to install an electric plant and develop 20,000 hp. It is said that the company will issue $2,000,000 in bonds. W. L. Roach, president of the Roach & Musser Sash & Door Company, is interested in the enterprise.

WAVERLY, IA.—The municipal electric light and water plant is reported to have been destroyed by fire Sept. 22, causing a loss of about $30,000.

ANTHONY, KAN.—The Citizens' Improvement Company is planning to install a 150-kw generator and a 200-hp engine in its electric light plant. W. A. Miller is manager.

ATCHISON, KAN.—Bids will be received by the Board of Education until Oct. 19 for electric wiring of the new high school building, plans and specifications for which are on file at the office of the Board of Education. H. B. Mine is chairman.

ELLIS, KAN.—An election will soon be held to vote on the proposition of establishing an electric light plant and water works system. The W. K. Palmer Company, Dwight Building, Kansas City, Mo., consulting engineers, have been engaged to prepare plans and take charge of the work.

GARDEN CITY, KAN.—The citizens are contemplating installing a new electric light plant.

GARDEN CITY, KAN.—It is reported that the first power plant to be erected by the Kansas-Colorado Electrical Transmission Company is to be located in Garden City, work on which will begin as soon as the bonds have been disposed of. It is expected to have the plant in operation by February, 1909.

LAWRENCE, KAN.—Machinery is now being installed in the new power and heating plant for the University of Kansas, on Mt. Oread. The equipment will include two 150-hp boilers furnished by the Kennicutt Water Softener Company, of Chicago, Ill.; a 225-hp cross-compound Ball engine and a 150-kw, three-wire Western Electric generator.

McPHERSON, KAN.—The City Council has passed a resolution offering the present owners $50,000 for the water and light plants. If after 30 days this offer is not accepted, the Mayor is authorized to call a special election to vote on the proposition to issue $60,000 to construct a water and light plant.

MANHATTAN, KAN.—E. A. Wharton and associates have made application to the City Council for a franchise to establish an electric light plant.

WINFIELD, KAN.—The Southwestern Interurban Railway Company will award contracts for the construction of an interurban railway in Arkansas City and Winfield, Kan., and also tracks for local systems in both cities during the next six months. Work on equipping the present street railway in Winfield to be operated by electricity has already commenced.

LOUISVILLE, KY.—The Board of Public Works has authorized the electric lighting franchise forfeited by Hardy Burton to be resold at auction on Oct. 6.

NEW ORLEANS, LA.—Plans are being made by the Cumberland Telephone & Telegraph Company for extensive improvements and extensions to its system in Louisiana, which will include the erection of 300 miles of new poles and several thousand miles of wire, work on which will soon commence. B. S. Read is district superintendent.

LIMERICK, MAINE.—The Limerick Water & Electric Company, a subsidiary company of the Limerick Mills, has commenced active work on the development of its water power at the Ledges, three miles from Limerick Village, and it is expected to have the plant in operation by Jan. 1. About 600 hp will be developed, which will be sufficient to operate the mills of the company and also furnish electricity for lamps in the village of Limerick and to operate an electric railway between East Waterboro and Limerick.

LIVERMORE, MAINE.—The Livermore Falls Light & Power Company is installing a street lighting system in Chisholm. The company has furnished electricity for commercial lighting in the town for some time.

BALTIMORE, MD.—Plans are being considered for the construction of a power plant for lighting and heating the city hall and court house, the cost of which is estimated at $150,000.

BALTIMORE, MD.—A movement is on foot to extend the electric service of the Patapsco Electric & Manufacturing Company to cover Mount Washington, Arlington and West Arlington, and later to extend it to the section of Baltimore County, which is now supplied with electricity by the Mount Washington Electric Power Company, a subsidiary of the Consolidated Gas, Electric Light & Power Company. The Patapsco Electric & Manufacturing Company has just completed its new power house on the Patapsco River, and offers to furnish electricity at a much less cost than now charged by the Consolidated Gas, Electric Light & Power Company. Victor G. Bloede is president.

HAGERSTOWN, MD.—It is reported that surveys are being made for New York capitalists for the establishment of an electric power plant in Hagerstown, the cost of which is estimated at $200,000. John W. Feldman, of Hagerstown, is said to be interested in the enterprise.

BERLIN, MASS.—The Marlboro Electric Light Company has been granted a franchise to extend its transmission line from Marlboro through Berlin to the Clinton line. By terms of the franchise the company is to furnish 32 incandescent street lamps of 40 cp, to be distributed through the three villages at a cost of $17.50 per lamp per year. The company is to furnish electricity to residences along the route at the same price paid in Marlboro.

CLINTON, MASS.—The citizens have voted to appropriate $1,000 to be used by the special committee appointed to investigate the question of municipal ownership of the lighting plants. The citizens have decided to purchase the plant of the Clinton Gas Light Company in Lancaster, if it is decided to take over the local lighting plants to be operated by the town. Major P. J. Cannon is clerk of the special committee.

EDGARTOWN, MASS.—The citizens are considering the question of having the streets lighted by electricity, the service to be secured from the plant of the Cottage City Gas & Electric Company, at Oak Bluffs, Mass.

FALL RIVER, MASS.—The Fall River Electric Light Company has applied to the City Council for permission to replace the present poles for electric lamps with new poles, which are a more durable and ornamental type. Albert F. Dow is treasurer of the company.

MANCHESTER, MASS.—A petition is in circulation calling for a special town meeting to consider the purchase of the plant of the Manchester Electric Company at a price not to exceed $150,000.

MARLBORO, MASS.—The Marlboro Electric Company is reported to have entered into a contract with the Connecticut River Power Company whereby the latter company is to furnish the Marlboro company with electricity to operate its system in Marlboro, Southboro and Northboro. The company does not intend to abandon its large power plant in Marlboro, but will purchase electricity to take care of new business instead of increasing the equipment of its plant. Charles S. Davis is superintendent of the Marlboro Electric Company.

NEW BEDFORD, MASS.—The special committee appointed by the City Council to consider and investigate the question of establishing a municipal electric light and gas plant has decided that it is not desirable for the city to undertake the enterprise under the present law.

SPENCER, MASS.—The Spencer Gas Company has issued a new schedule of prices for electricity for incandescent and arc lamps, small single-phase motors, etc., to take effect from Aug. 1, as follows: For the first 100 kw-hours per month the rate will be 20 cents per kw-hour, less 25 per cent discount; all in excess of 100 kw-hours per month the price will be 20 cents, less 40 per cent discount, making the prices 15 and 12 cents per kw-hour, respectively. A minimum monthly charge for one or two lamps will be $1 per lamp per month. The company will furnish arc lamps and keep them trimmed and in repair for $1 per month, plus the cost of electricity at regular rates.

WAKEFIELD, MASS.—The special committee appointed to investigate the question of making improvements to the municipal electric light plant has recommended that electricity for operating the plant be purchased from the Malden Electric Company and advises the town to petition the Legislature for permission to purchase energy from outside parties. The committee also recommends that the street lighting system be reconstructed and discarding all but 50 arc lamps, substituting 400 tungsten lamps; also the installation of a new switchboard. The citizens voted to appropriate $5,500 to rebuild the street lighting system and for switchboard.

CHARLOTTE, MICH.—It is reported that the Michigan Power Company, of Lansing, Mich., is making investigations in this vicinity, with a view of erecting a transmission line to furnish electricity for lighting the streets of Charlotte, Bellevue and Olivet. Private contracts for street lighting have expired in the above-named towns and it is said that the citizens of Olivet are contemplating installing an electric plant.

MORENCI, MICH.—The local electric light plant has been purchased by G. F. Avis, of Hudson, Mich., and Mills Lamb. The new owners contemplate making improvements to the plant and extending the transmission lines at once.

HATTIESBURG, MISS.—The Home Telephone Company is making arrangements to erect a long-distance telephone line connecting Jackson and Memphis, via Greenwood and Holly Springs.

MERIDIAN, MISS.—Plans are being prepared by William G. Wiles, manager of the Meridian Water Works, for a street lighting system, to cost approximately $60,000.

YAZOO CITY, MISS.—The bonds issued by Yazoo City for the construction of an electric railway have been taken by the State Trust Company, of Vicksburg, Miss. The trust company will build the railway, for which contracts have been awarded, and when it is completed will turn it over to the city, which will operate it. The power house will be built by the city, under the supervision of T. W. Pocklington. The equipment will include an engine and generator furnished by the Southern Electric Company and also a Buckeye engine. The railway will be about four miles in length and will be completed and in operation by Jan. 1, 1909.

ELSBERRY, MO.—The citizens have voted to issue $10,000 in bonds to establish a municipal electric light plant.

ST. JAMES, MO.—The new electric light and power plant, owned by Chris Koeln and associates, has been placed in operation and is furnishing electricity for lighting the streets and residences of the town.

ST. LOUIS, MO.—The application of the King Electric Light Company for the extension of its franchise in St. Louis County from the present boundary to extend all over the county has been granted by the county court.

ST. LOUIS, MO.—The West End Light & Power Company, owning the franchise granted to Browning, King & Company, in March, 1884, has filed a bond for $20,000 as a guarantee that it would comply with the provisions of the ordinance. The company has applied for a franchise to erect electric transmission lines between Lindell and Laclede Avenues

and Newstead Avenue and Kingshighway. Jesse O. Dana is president of the company.

BILLINGS, MONT.—Surveys are now being made by the Billings & Cooke City Railway Company for its proposed electric railway from Cooke City to Billings, via Nye, Dean, Joliet and Laurel. Work on construction of the railway will begin about Oct. 1. Electricity for operating the system will be furnished by the Stillwater Power Company from a plant, which is to be built at Stillwater Canyon. The officers of the company are: J. B. Clayburg, of Helena, Mont., president; A. L. Babcock, of Billings, vice-president and treasurer, and George H. Savage, of Billings, secretary and general manager.

BUTTE, MONT.—The Madison River Power Company is planning to erect steel towers to replace the wooden poles which now support the wires of its transmission line from its plant located on the Madison River. The transmission line will be 61 miles in length and will cost about $250,000. Work will commence on construction of the line as soon as the material can be secured.

McCOOK, NEB.—Plans have been submitted by the McCook Electric Light Company for its proposed new power house, the cost of which is estimated at $5,000.

WYMORE, NEB.—It is reported that Black Brothers are planning to install an electric light plant to be operated in connection with their mill, and have offered to furnish electricity to light the streets of the town for less than the Electric Service Company is now furnishing the service.

FARMINGTON, N. H.—Plans are being prepared by W. D. Allen for making an addition to his electric light and power plant, which include the installation of a Curtis turbo-generator set to replace the Fitchburg engine now in use. The new equipment will give the plant an output of 225 hp.

PATERSON, N. J.—The contract for the construction of the electric railway between Paterson and Suffern, a distance of 15 miles, has been awarded to John R. Lee, of Paterson, and 170 Broadway, New York, N. Y. The total cost of the railway is estimated at $500,000. William Barber, of Paterson, N. J., is president, and Malcolm R. McAdoo, of Montclair, N. J., vice-president.

RAHWAY, N. J.—Bids will be received by Richard H. Wilson, president New Jersey Reformatory Commission, at the New Jersey Reformatary, Rahway, N. J., until Oct. 7, for supplying 1000 incandescent lamps of 8 cp, Edison base; 100 incandescent lamps of 16 cp, Edison base.

AUBURN, N. Y.—Arrangements are being made by the Auburn Light, Heat & Power Company to double the output of its plant. The present boilers are to be replaced with a triple set of boilers of greater capacity. M. C. Turpin is superintendent.

BATH, N. Y.—The Public Service Commission has granted the Citizens Electric Service Company permission to issue $75,000 in bonds and $50,000 in capital stock. The company holds a franchise to erect an electric light and power plant and steam heating system in Bath, and it also has a contract to light the streets of the towns with electricity.

BROOKLYN, N. Y.—Bids will be received by C. B. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until Oct. 5 for installing electric equipment in new public school 157, Borough of Brooklyn.

BUFFALO, N. Y.—The Public Service Commission, Second District, has granted the Cataract Power & Conduit Company permission to issue $120,000 in bonds, the proceeds of which are to be used for extensions and improvements to its plant.

CANANDAIGUA, N. Y.—The contract for electric wiring the court house at Canandaigua has been awarded to the Rudolph Schmidt Company, of Rochester, N. Y., for $2,990. Ralph M. Simmons is supervisor.

FORT PLAIN, N. Y.—The Village Trustees have granted the Glen Telephone Company permission to construct underground conduits through the streets of the village.

HICKSVILLE, N. Y.—The Public Service Commission has granted the New York & North Shore Traction Company permission to extend its electric railway from Hicksville to Mineola.

KEESEVILLE, N. Y.—The Village Board has granted a franchise to the Clinton Telephone Company to erect a telephone system in Keeseville.

LITTLE FALLS, N. Y.—The Council has granted the Utica Gas & Electric Company permission to extend its mains in this city. The Council has also granted the Hudson River Electric Company an extension of time until May 1, 1909, for its franchise to build the Spier Falls-Utica transmission line.

MEXICO, N. Y.—The Public Service Commission, Second District, has granted the Mexico Electric Company permission to issue $10,000 in bonds, the proceeds to be used for the purpose of purchasing the local electric light plant, owned by E. L. Huntington, of Mexico. The commission also has approved of the transfer of the plant to the Mexico Electric Company for a consideration of $5,000 in cash and $10,000 in bonds.

NEW YORK, N. Y.—Bids will be received by J. W. Stevenson, commissioner of bridges, 13 Park Row, New York, N. Y., until Oct. 7, for the installation of electric wiring, lamps, fixtures, etc., for the lighting of the Blackwell's Island Bridge. Blank forms and specifications may be obtained at the office of the Department of Bridges.

ONEIDA, N. Y.—Plans are being considered by the Madison County Gas & Electric Company to change its entire system from 60 to 40 cycles and installation of a generator, switchboard and other equipment. E. J. Kenney is manager.

ROCHESTER, N. Y.—Arrangements are being made for the construction of a storage battery station at the foot of Factory Street, the cost of which is estimated at $10,000.

SYRACUSE, N. Y.—The Onondaga Telephone Company is planning to complete its system in this city, which will involve an expenditure of about $350,000. It is said that about 40 miles of cables will be placed in the subways and 150 miles on poles.

TRUMANSBURG, N. Y.—The Board of Trustees has entered into a contract with the Ovid Electric Company for lighting the streets of the village for a term of five years. Thirteen arc lamps are to be retained on Main and Cayuga Streets, and the remainder will be exchanged for nearly twice the number of 100-cp tungsten lamps. The company will make improvements to its system, which will involve an expenditure of from $2,000 to $2,500.

GOLDSBORO, N. C.—The Goldsboro Traction Company is planning to construct a street railway system, two miles in length, work on which will soon begin. E. T. Oliver is owner of the franchise.

FAYETTEVILLE, N. C.—The mills of Fayetteville will be deprived of electrical power for two months, owing to the electric plant of the Carolina Power & Light Company at Buckhorn Falls, N. C., being put out of commission, due to the earth embankment at the end of the dam being washed away. Charles E. Johnson, of Raleigh, N. C., is president of the company.

FAYETTEVILLE, N. C.—The Fayetteville Street Railway & Power Company is reported to have placed a contract with the Ideal Electric Company, of Charlotte, N. C., for erecting the overhead system in connection with changing its street railway to be operated by electricity instead of gasoline motors as at present. William D. McNeil is president of the street railway company.

SHELBY, N. C.—Plans are being prepared by the management of the Shelby Cotton Mills for increasing the output of the mills, which include the erection of new buildings and installation of new machinery, and will involve an expenditure of about $100,000. Electricity will be used for motive power. C. C. Blanton is president.

LIMA, OHIO.—The City Council has passed an ordinance repealing the ordinance authorizing the Board of Public Works to proceed with the construction of a municipal electric light plant.

MANSFIELD, OHIO.—Plans are being prepared by the Mansfield Railway, Light & Power Company to double the output of its plant, which include the purchase of a 1000-kw turbine and boilers of 500 hp.

NEW CONCORD, OHIO.—The City Council is reported to be considering the question of constructing a municipal electric light plant.

ROCKFORD, OHIO.—The plant of the Rockford Milling Company, which furnishes electricity for street lighting, was destroyed by fire recently. The streets of the town have been in darkness since.

TOLEDO, OHIO.—Electricity for operating the system of the Toledo & Western Railroad Company is now furnished by the Toledo Railways & Light Company. The substations of the railway company along the line will be improved and new stations added as needed. The power plant of the Toledo & Western Railroad Company at Sylvania has been closed.

XENIA, OHIO.—Contracts for furnishing material and construction of new power plant and remodelling the present lighting and water system for the Ohio Soldiers' and Sailors' Orphans' Home has been awarded by the Board of Trustees as follows: For construction of buildings, tunnels and stacks, to Contractor Leister of Dayton, Ohio, for $25,567, and for equipment, to Huffman & Conklin, of Columbus, Ohio, for $35,845.

STIGLER, OKLA.—R. E. Stalcup has been granted a franchise to establish an electric light plant in Stigler. It is said that a company will be organized with a capital stock of $20,000 to carry out the project.

ASTORIA, ORE.—The Oregon Coast Railway Company has applied to the City Council for a franchise to construct an electric railway on several streets of the city.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Oct. 22 for furnishing copper, boiler tubes, wire rope, electrical material, wire, etc., as per circular No. 471. Blanks and general information relating to the above circular can be obtained at the office of the purchasing agent, or the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is purchasing officer.

PANAMA.—A site has been determined on for the power house at Catun, Isthmus of Panama, work on which will begin at once. The equipment will consist of six 400-hp water tube boilers of the Keeler type, equipped with induced draught fans in duplicate; three 1500-kw General Electric Curtis three-phase, 25-cycle, base-condenser turbo-generators; the substation will be equipped with two 500-kw and one 300-kw rotary converters with the necessary auxiliary apparatus. A 20-ton, three-motor crane will run the length of the engine room. The plant will furnish electricity for unloading at the docks, for motors on the lock cableways and for the cable road, and will probably be maintained as an emergency plant to the hydraulic power plant that will furnish power to operate Gatun Locks after the canal is completed.

JOHNSTOWN, PA.—The Franklin Extended Electric Company has applied to the City Council for a franchise to furnish electricity in this city. The company offers to furnish electricity for domestic use at the rate of 7 cents per kw-hour, and to furnish arc lamps at $40 per lamp per year, and also agrees to pay the city $5,000 if the franchise is granted.

NAZARETH, PA.—The Nazareth Electric Light & Power Company has entered into a contract with the Easton Power Company, of Easton, Pa., to furnish electrical energy for operating its system. It is expected to have the work of connecting the transmission lines completed by Oct. 15.

PITTSBURG, PA.—The A. W. Wykoff Company, of Pittsburg, is installing two 300-kw generators in the Boggs & Buhl Building, Northside, and a 600-kw dynamo in the Oliver power house in this city.

PAWTUCKET, R. I.—The City Council has entered into a contract with the Pawtucket Electric Company for lighting the streets of the city for a term of 10 years. Under the new contract the company will furnish arc lamps at $105 per lamp per year on an all-night schedule and $70 per year per lamp, lamps to burn until 1 a. m. Under the old contract the city paid $112.50 each per year on all-night service and $72.50 each for the 1 o'clock schedule. In addition, the lamps are to burn every night on both circuits, instead of the moonlight schedule, as before.

CUSTER, S. D.—Plans have been prepared by the Westinghouse Electric & Manufacturing Company for a power plant on French Creek, where 600 hp will be developed. It is proposed to furnish electricity for the various mines and factories and for lighting in Custer.

DALLAS, S. D.—Plans are being considered to construct a telephone line to the Rosebud Agency, covering a distance of 150 miles.

BRYAN, TEX.—A committee has been appointed by the City Council to secure plans and estimates for establishing a municipal electric light plant. For further information inquire of G. M. Brandon.

CLAYTON, TEX.—The business men of Clayton are making arrangements to erect a telephone line from Clayton to Central City and thence to Nama Visa, through Cone, Rosebud Valley, Dale, Ione and Ohmego.

CORPUS CHRISTI, TEX.—The People's Light Company, recently chartered, will construct an electric light and power plant at a cost of about $30,000, for which part of the machinery and equipment required has already been purchased. The company is in the market for a steam-driven unit, with a rating of from 75 to 100 kw, to be placed in an ice plant as a reserve unit to the producer gas unit operating the plant. Thomas E. Craig is manager.

FORT SAM HOUSTON, TEX.—Bids will be received by L. J. Fleming, constructing quartermaster, U. S. A., until Oct. 28, for furnishing and installing an invalid's electric elevator in the hospital at this post.

MARSHALL, TEX.—The Marshall Traction Company is contemplating the construction of an electric railway in Marshall, about three miles in length. Marvin Turney, of Marshall, is interested in the project.

SEGUIN, TEX.—The Seguin Electric Light & Power Company contemplates rebuilding its hydro-electric plant and will probably install new water wheels.

SHERMAN, TEX.—The citizens on Sept. 19 voted in favor of issuing $14,000 in bonds for the construction of an electric light plant and $16,000 for water works system. Bids for bonds will be received until Oct. 19. George Stephens, of Sherman, is engineer in charge of the work.

BASIC CITY, VA.—The Town Council has voted to issue $25,000 in bonds, the proceeds of which are to be used for the construction of a municipal electric lighting plant, sewerage system and extension of water mains and street improvements. Bids for bonds will be received until Nov. 2. W. H. Gardner is mayor.

LEESBURG, VA.—The Leesburg Telephone Company has been granted a franchise to erect a telephone system in Leesburg, Va., work on which will begin in the near future.

BELLINGHAM, WASH.—The Nooksack Valley Traction Company has applied to the City Council for a franchise to construct an electric railway in the city, four miles long. The company proposes to build an electric railway between Bellingham and Blaine, and Bellingham and Sumas.

NORTH YAKIMA, WASH.—Plans are being made by the Northwest Light & Water Company to extend its system between Yakima and Kennewick, to furnish electricity for lamps and motors, the cost of which is estimated at $250,000. The company has a large hydro-electric plant at North Yakima and is planning to develop another water power at Kennewick. George Arrowsmith is superintendent.

SEATTLE, WASH.—Stone & Webster, of Boston, Mass., have secured control of the Seattle-Everett Interurban Railway, a new electric railway projected by Fred E. Sander and associates, part of which has been completed. The Interurban Railway will be consolidated with the Seattle Electric Company. It is said that the railway will be extended from Everett to Bellingham.

SPOKANE, WASH.—The Big Bend Transit Company is reported to be making preliminary arrangements to build its proposed electric railway from Spokane to the Columbia River. The company has decided to increase its capital stock from $100,000 to $3,000,000. The company has secured several power sites along the Spokane River, one of which is located near the mouth of the river, and has also been granted riparian rights by the government for a mile and a half along the Columbia River, above the junction of the Spokane River.

TACOMA, WASH.—The Thunder Creek Transportation & Smelting Company is preparing plans for the construction of an electric railway about 22 miles in length. A. M. Richards is president of the company and H. J. Fuller is chief engineer, both of Tacoma, Wash.

WENATCHEE, WASH.—The Farmers' Telephone & Telegraph Company has applied for a franchise to erect telephone lines in Chelan County.

CHARLESTOWN, W. VA.—The White City, recently incorporated to construct an amusement park, is preparing plans for building a power plant to furnish electricity for lamps and motors in the park, and to furnish energy for lighting Spring City, Va.; also for lamps and motors to the State Institute and Farm Home. Paul Grosscup is president of the company.

ELKINS, W. VA.—The Elkins Electric Railway Company is constructing a temporary power station on the Viquesney Farm, near Elkins, in which a 150-hp gas engine will be placed. The permanent power station will be located at Roaring Creek Junction.

IRON RIVER, WIS.—It is reported that the Iron River water, light and power plant was recently destroyed by fire, causing a loss of about $10,000.

KAUKAUNA, WIS.—The City Council has notified the Kaukauna Gas, Electric Light & Power Company that the contract for street lighting, which expires Oct. 14, will not be renewed, owing to the large number of complaints made in regard to the service.

MILWAUKEE, WIS.—The Milwaukee Light, Heat & Traction Company has been granted permission to extend its railway from Waterford to Lake Geneva.

OCONTO FALLS, WIS.—It is reported that an independent telephone line is to be erected from Oconto Falls to Sampson.

LETHBRIDGE, ALB., CAN.—Cecil B. Smith, of Toronto, hydro-electric expert, has been engaged to prepare plans and specifications for the new municipal electric light and power plant.

NELSON, B. C., CAN.—Cecil B. Smith, hydro-electric expert of Toronto, has been instructed to prepare plans at once for a second unit at the municipal power station at Donnington Falls. G. H. Bolton is city clerk.

NELSON, B. C., CAN.—The City Council has decided to reduce the price of electricity for lamps supplied from the municipal plant. The new rates will be as follows: First 50 kw, 12 cents per kw-hour; second 50 kw, 11 cents; next 100 kw, 10 cents; next 200 kw, 9 cents; next 300 kw, 8 cents; next 300 kw, 7 cents; next 500 kw, 6 cents; next 500 kw, 5 cents, and all over 2000 kw, 4 cents. A discount of 10 per cent will be allowed on all accounts paid before the 15th of the month. G. H. Bolton is city clerk.

WINNIPEG, MAN., CAN.—The contract for the whole of the steel work at St. Andrews Locks has been awarded to the Canada Foundry Company and the Canadian General Electric Company by the Dominion Government. The contract involves an expenditure of about $600,000, and includes all the steel work on the locks, dam and bridge, together with the steam and electrical installation for handling the curtain locks.

WINNIPEG, MAN., CAN.—It is stated that the offer of the Winnipeg Electric Company to supply electricity to the city at $18.40 per hp was not based on a meter rate, but on a 24-hour rate. Under the contract submitted by the company the city would be compelled to take 10,000 hp annually whether it was used or not, at a cost of $184,000 per year. In addition, the city would have to build a distributing plant. It is not considered likely the offer will be accepted. F. E. Cambridge is city electrician.

BRANTFORD, ONT., CAN.—The Lyons Electrical Company is installing a large generator in its plant at Burford, Ont., for the purpose of improving the lighting service in that village.

BROCKVILLE, ONT., CAN.—The streets of the town are in darkness owing to the municipal electric light plant having been damaged by fire. The loss is estimated at $5,000.

HAMILTON, ONT., CAN.—Bids will be received by the Department of Public Works, until Oct. 8, for combined gas and electric light fixtures for Armory at Hamilton. Plans and specifications can be seen and forms of tender obtained at the Department of Public Works and on application to Stewart & Witton, Hamilton, Ont., architects. N. Tessier is secretary of board.

PORT ARTHUR, ONT., CAN.—The Kaministiquia Power Company, Fort William, Ont., has made a proposition to this city to erect a substation in Port Arthur to supply electricity in this city. J. McTeigue is city clerk.

PORT ARTHUR, ONT., CAN.—We are advised that the information published by the local newspapers and noted in our issue of Sept. 5, stating that "the plans of Cecil B. Smith for a new power house to cost $40,000 were rejected and it was decided to accept plans prepared by Mr. Smith for an $8,000 structure," is incorrect. The facts are that plans were prepared for the construction of two concrete reservoir dams, one to replace the dam destroyed by flood and one to reinforce a storage dam now in place. The plans have been accepted without change and contracts awarded. The cost of the work will involve an expenditure of about $60,000.

MELVILLE, SASK., CAN.—The town is negotiating with the Grand Trunk Pacific Railway Company to furnish electricity for lighting the town.

REGINA, SASK., CAN.—The proposition of obtaining electrical power from the Dirt Hills, 60 miles distant, is being considered by the city officials.

MEXICO CITY, MEX.—Negotiations are under way by which the Mexico Tramways Company will take over the properties of the Mexican Electric Light & Power Company under lease. The preliminary agreement, which must be ratified by the stockholders of the two companies, provides that the Mexico Tramways Company shall guarantee the interest on first payment of the bonds and interest on the preferred stock of the Mexican Electric Light & Power Company and a minimum interest of 4 per cent on the common stock of the company, together with an equitable division of greater profits. The tramway company agrees to provide at least $6,000 000 and as much more as may be needed to complete the hydro-electric plant at Necaxa, increasing the output of the plant from 40,000 to 80,000 hp, and funds for other improvements as may be necessary. Plans have been made for the installation of two additional generators in the main hydro-electric plant at Necaxa. The demand for electricity for motors in the city of Mexico and the mining camp of Eloro has made it necessary to increase the output of the plant.

New Industrial Companies.

THE NATTICAL APPARATUS COMPANY, of Wilmington, Del., has been chartered, with a capital stock of $100,000, to manufacture and deal in all kinds of electrical apparatus.

THE MULTIUNIT GAS ENGINE COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $25,000, by James J. Maloney, Alfred C. Gary and William L. Simonton.

THE COLONIAL FAN & MOTOR COMPANY, of Warren, Ohio, has been chartered, with a capital stock of $10,000, by J. B. Estabrook, E. E. Nash, Robert W. Bean, F. E. Watts and D. R. Estabrook.

THE GOSHEN MOTOR WORKS COMPANY, of Goshen, Ind., has been incorporated, to establish and equip a plant to manufacture electric and gasoline engines, boilers, vehicles, automobiles, tools, gasoline and electrical appliances.

THE MALUGEN ENGINE COMPANY, of Nashville, Tenn., has been incorporated, with a capital stock of $4,000,000, to manufacture steam engines. The incorporators are George A. Clark, John D. Fletcher, L. E. Thompson and others.

THE ARROW ELECTRIC COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $2,500, to manufacture and deal in electrical appliances and apparatus, by William M. R. Vose, Hubert E. Page and William C. McNitt.

THE DES MOINES ELECTRIC COMPANY, of Augusta, Maine, has been incorporated, with a capital stock of $3,500,000, to manufacture and sell electrical machinery. J. Berry is president and treasurer, and L. A. Burleigh, clerk, both of Augusta, Maine.

PEET & POWERS, of New York, N. Y., has been incorporated, with a capital stock of $10,000, to engage in an electrical and mechanical engineering business. The incorporators are W. Creighton Peet, Walter H. Powers and Townsend Morgan, all of New York, N. Y.

THE INTERNATIONAL TELEPHONE COMPANY, of Boston, Mass., has been chartered, with a capital stock of $200,000, by Herman L. Hahn, of Boston, Mass., treasurer and clerk, and Arthur M. Cobb, of Lynn, Mass. The company proposes to manufacture electrical goods.

THE AUTOMATIC ELECTRIC SIGNAL COMPANY, of Portland, Maine, has been chartered, with a capital stock of $1,000,000, to manufacture and sell electric signals and devices. F. I. Moore is president and treasurer, and J. F. Fagan, clerk, both of Portland, Maine.

THE GREAT NORTHERN ENGINEERING & SUPPLY COMPANY, of New York, N. Y., has been chartered to do general contracting work. The company is capitalized at $10,000 and the incorporators are William S. Congalton, Henry Woog, George M. Brooks, all of New York, N. Y.

THE RAILWAYS & ELECTRIC CONSTRUCTION COMPANY, of Bath, N. Y., has been incorporated, with a capital stock of $100,000, by F. H. Ely, E. C. Lockwood and E. S. Jones, of New York, N. Y. The company will carry on a building, contracting and engineering business.

THE CROSSLEY MACHINE COMPANY, of Trenton, N. J., has been incorporated, with a capital stock of $125,000, by Harry D. Leavitt and Donald M. Miller. The company proposes to carry on the business of electrical engineers, machinists, foundry and manufacturing business.

THE NEW YORK DYNA-BATTERY COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $50,000, by Herman M. Underwood, Fred S. Ashley and Jacob G. Lazarus, all of New York, N. Y. The company proposes to manufacture and sell dyna-battery machines.

THE ARC LAMP COMPANY OF AMERICA, of New York, N. Y., has filed articles of incorporation, with a capital stock of $100,000, by Edward B. Rich, of Brooklyn, N. Y.; Robert S. Kennedy and George S. Jacob, of New York, N. Y. The company proposes to manufacture electric lighting machinery, lamps, etc.

HOULTON MOTOR & MANUFACTURING COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $200,000, to manufacture and sell hydrocarbon motors. The officers of the company are: Albert C. Morrison, president; Sylvanus T. LeBarron, treasurer, and Philip C. Jack, clerk, all of Boston, Mass.

THE ENGINEERING & CONSTRUCTION COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $10,000, and proposes to do civil, mechanical, electrical and sanitary engineering work. The incorporators are: Herman M. Underwood, John Marvin and Richard A. Waite, all of New York, N. Y.

THE EDWARDS & MITCHELL ELECTRIC COMPANY, of Boston, Mass., has been chartered, with a capital stock of $5,000, to manufacture and deal in electrical apparatus. The officers of the company are: Harold T. Mitchell, of Malden, Mass., president and clerk; John E. Edwards, of Everett, Mass., treasurer, and Samuel W. Culver, clerk.

THE NONPAREIL ELECTRICAL MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $50,000, to manufacture and deal in electrical supplies. The incorporators are: Charles S. Shuman, Augustus F. Braatz, of New York, N. Y., and Edward M. Speers, of Edgewater, N. J.

THE INTERNATIONAL WIRE COMPANY, of New York, N. Y., has been chartered, with a capital stock of $250,000, by A. A. Harrison, J. A. Walsh, of Brooklyn, N. Y., and E. H. Cook, of Wilkesbarre, Pa. The company proposes to carry on a business of contracting, electrical and mechanical engineering, also manufacturing cars and trucks.

THE ELECTRICAL COMPANY, of Morristown, N. J., has filed articles of incorporation and proposes to manufacture electrical metal and alloys used in manufacture of electrical apparatus. The company is capitalized at $50,000, and the incorporators are: F. S. Reigart, of New York, N. Y.; W. H. Kissam, of West Orange, N. J., and J. E. Undercliff, New York, N. Y.

THE DUNDEE BRASS MANUFACTURING COMPANY, of Dundee, N. Y., has been incorporated by Henry Fernandaugh, of New York, N. Y.; Charles Goble, E. L. Bailey, T. D. Beekman and C. C. Harvey, of Dundee. The company proposes to manufacture electric fixtures, brass fittings and specialties. Plans are being made for the construction of a plant at Dundee, N. Y.

THE TOLEDO ELECTRIC VEHICLE COMPANY, of Toledo, Ohio, has been incorporated, with a capital stock of $50,000, by Willard E. Allen, A. F. Clark, Frederick B. Willard, E. J. Hall and J. W. Schaufelberger. This company will take over the Allen & Clark Company, which has been operated as an experimental concern in perfecting a storage battery designed by A. F. Clark. The old riding academy at the corner of Collingwood and Delaware Streets has been leased and a factory for the manufacture of runabouts will be opened at once.

Company Elections.

CLOVERDALE, CAL.—At the annual meeting of the Cloverdale Light & Power Company the following officers were elected: A. Sbarboro, of San Francisco, Cal., president; P. Rossi, of San Francisco, secretary and manager; Italian-American Bank, treasurer, and C. A. Feldmeyer, superintendent. The company is planning to extend its transmission lines during the next year.

TIVERTON, R. I.—At the annual meeting of the Tiverton Electric Light Company the following named officers were elected: John R. Hicks, president; Owen Durfee, treasurer, and George R. Lawton, clerk. It is stated that work on the construction of the transmission lines in Tiverton would begin at an early date. It is probable that the Fall River Electric Light Company will furnish electricity to operate the system.

New Incorporations.

HANFORD, CAL.—The Hanford-Fresno Electric Railroad Company has been incorporated with a capital stock of $60,000 by F. S. Granger, L .A. Nares, A. B. Clark, E. M. Harris, A. B. Livermore, A. V. Taylor, Joseph R. Biddle, R. L. Pfiel and William Sage. L. A. Nares was elected president.

OAKLAND, CAL.—The Tuolumne Water Power Company, capitalized at $1,000,000, has been incorporated by Warren Gregory and H. H. Rolfe, of San Francisco; Winfield Dorn, of Oakland; Geo. H. Whipple, of Alameda, and J. S. Lanson, of Berkeley.

SAN FRANCISCO, CAL.—The Ocean Shore Lighting Company has been incorporated, with a capital stock of $100,000, by W. R. Bartley, W. J. McFarland, C. A. Arata, T. E. Whitmore and C. F. Grondona.

SAN FRANCISCO, CAL.—The California Company has been incorporated, with a capital stock of $2,500,000, by C. W. Conlisk, R. A. Morton, C. H. Lind, George James, Frank E. Conise and Russell B. Field. The company proposes to construct a railway from San Francisco to Sacramento, with branches to Petaluma and Napa. The railway will be about 118 miles in length. It is said that the company is practically a preliminary merger that will include the Bay Counties Railway Company, the Napa & Sacramento Railway Company and the Napa & Vaca Valley Railway Company. The main line of the California Company will run from Richardson's Bay to Sacramento, a distance of 95 miles.

WILMINGTON, DEL.—The Johns River Heat, Light & Power Company has been incorporated with a capital stock of $500,000 by Elisha

W. Meloney, of Avondale, Pa.; Benjamin F. Groff, of Lancaster, Pa., and Charles B. Evans, of Newark, Del.

SANFORD, FLA.—The Sanford Electric Light, Gas Fuel & Power Company has been incorporated with a capital stock of $150,000 and the following officers: Andrew Johnson, president; M. M. Smith, of Winter Park, Fla., vice-president; W. D. Holden, of Orlando, Fla., secretary and treasurer.

GALESBURG, ILL.—The Galesburg, Aledo & Northwestern Railroad Company has filed articles of incorporation, with a capital stock of $10,000, to construct an electric railway from Galesburg to Aledo, and from there to Rock Island, Ill. The incorporators are Lafayette Weinberg, G. R. Churchill, F. W. Larimer, B. F. Arnold, E. R. Drake, Charles L. Hibbard, C. F. Hurburgh, L. W. Sanborn and Thomas W. Peterson.

ROANOKE, ILL.—The Roanoke Telephone Company has filed articles of incorporation, with a capital stock of $2,000. The incorporators are P. W. Kennell, E. W. Redinger and J. J. Beer, Jr.

CRAWFORDSVILLE, IND.—The Pleasant Shades Power Company has been incorporated with a capital stock of $100,000 for the purpose of developing a hydro-electric plant in connection with a pleasure and health resort. The plans include the construction of a dam 20 ft. high across Sugar Creek and a power house, equipped with turbines and generators.

GOSHEN, IND.—The Kendallville, Ligonier & Goshen Traction Company has been incorporated and the following-named officers elected: Elmer McCray, president; Haines Egbert, of Goshen, Ind., vice-president; C. C. Bayer, of Kendallville, secretary and treasurer. The company proposes to build an interurban railway between this city and Kendallville through Ligonier, with branches to Albion and Rome City, connecting with the main line at Brimfield.

KENDALLVILLE, IND.—Articles of incorporation have been filed for the Kendallville, Ligonier & Goshen Traction Company. The capital stock is placed at $10,000, and the officers are: Elmer McCray, president; Haines Egbert, of Goshen, vice-president; C. C. Bayer, of Kendallville, secretary and treasurer.

VALPARAISO, IND.—The Valparaiso & Northern Railway Company has been incorporated with a capital stock of $10,000 to build and operate street and interurban railways in Porter County. The first railway will extend from Valparaiso to Chesterton. A local system will also be constructed in Chesterton. The directors are: George G. Pfleger, L. E. Woodard, D. R. Chase, M. J. Cook and W. R. Watson, all of Chicago, Ill.

DES MOINES, IA.—Articles of incorporation have been filed for the Des Moines, Council Bluffs & Western Railway Company by Robert Pilmery, Norwalk, Ia.; N. W. Hansen, Haslith, Ia.; R. S. Bannister, of Des Moines, Ia., and A. P. Sawyer, of Pierre, S. D. The company is capitalized at $100,000, and proposes to build an electric railway from Council Bluffs to Des Moines, with an extension to Muscatine, Ia.

AVIS, KY.—The Avis Telephone Company has been incorporated, with a capital stock of $210, by J. C. Halt, Alonzo Harris and William Blair.

CAMP KNOX, KY.—The Camp Knox & Middletown Telephone Company has been incorporated, with a capital stock of $200, by T. J. Mercer, J. J. Booker and Albert Mercer.

WESLEY, MAINE.—Articles of incorporation have been filed for the Equalized Telephone Association, with a capital stock of $10,000. The company proposes to own and operate telephone systems. The officers are: S. G. Gay, president; L. A. Gray, treasurer, and G. A. Day, clerk, all of Wesley, Maine.

LUCEDALE, MISS.—The Lucedale Light & Power Company has been incorporated with a capital stock of $5,000, by G. M. Luce, of Mobile, Ala.; W. D. Tatliff, J. A. Dorset and others, of Lucedale, Miss.

PLATTSBURG, MISS.—Articles of incorporation have been filed for the Plattsburg Telephone Company, with a capital stock of $10,000, by H. M. Woodall, of Plattsburg, Miss.; P. C. Meyer, Vowell, Miss.; J. L. Yarbrough, of Nexapater, and others.

KANSAS CITY, MO.—Articles of incorporation have been filed for the W. F. Lyons Ice & Power Company, with capital stock of $150,000, by W. F. Lyons, A. A. McDonough and Vernon H. Greene.

GIBBON, NEB.—The Gibbon Electric Light Company has been incorporated with a capital stock of $10,000 by Frank Hershey and others.

WOLBACH, NEB.—Articles of incorporation have been filed for the Wolbach Telephone Company, with a capital stock of $30,000, by E. D. Gould, C. Bradley and M. Mathew.

HEUVELTON, N. Y.—The Heuvelton Heat, Light & Power Company has been incorporated, with a capital stock of $25,000, by E. L. Thornton, E. F. Thornton, of Chicago, Ill., and A. Thornton, of New York.

VALATIE, N. Y.—Articles of incorporation have been filed for the Valatie Telephone Company with a capital stock of $10,000 by Edwin D. Howe, Wilson Miller, Remus E. Lester, of Valatie.

Legal.

ELECTRIC COMPANY LIABLE FOR INJURIES TO PERSON ON HIGHWAY ONLY WHEN HE IS MAKING A REASONABLE USE OF SAME.—The right of a traveler upon the highway to recover damages from an electric company for injuries received depends on whether his use of the highway is a reasonable one. Under this rule, it was held that the act of a pedestrian on a city street in placing his hand on an electric light pole in the street is not, as a matter of law, an unreasonable use of the street, and, under the circumstances recited, the company, owning a cable attached to the pole, and which came in contact with the pedestrian's hand and caused the injury complained of, was held legally responsible. The court refused to charge the jury to the effect that the pedestrian had no right to touch the cable unless it interfered with his passage along the highway. The court said in its opinion: "Travelers upon public highways have the right to do all acts reasonably incident to a viatic use of the way. There may be a difficulty in maintaining as law the proposition that a sidewalk, so situated as to be naturally and inevitably used for the hygienic purpose of a reasonable frolic of children on their way home from school, cannot be so used without being transformed from a way into a playground, or that by the gambols of young animals on their way to pasture their use of the road as a way is abandoned. As to such acts, and as to the incidental diversions of persons of mature years, the rule is that the point at which such diversions pass the bounds of legitimate recreation as a proper use of a highway is to be found by solving the question of reasonable use as a question of fact." Lydston vs. Rockingham County Light & Power Company, Supreme Court of New Hampshire, 70 Atl. Rep. 385.

Personal.

MR. FRANK H. TAYLOR has resigned as vice-president of the Yale & Towne Manufacturing Company, but remains on the board of directors of the company.

MR. F. A. SAGER, of the B. J. Arnold Company, read a paper before the Electric Club of Chicago last week on the subject of the electrification of steam railroads.

MR. FRANK J. QUINN, for the past 15 years purchasing agent of the Pacific Telephone & Telegraph Company, has become a director of the Sterling Electric Company, of San Francisco, and has taken up the duties of treasurer of the company.

MR. J. CONNER, works manager for Dick, Kerr & Co., of England, is on a visit to this country and will stay here during October to participate in the street railway convention at Atlantic City. Mr. Conner is visiting Schenectady, Pittsburg and other points of electrical interest.

MR. E. C. ZECHURE, editor in chief of the *Elektrotechnische Zeitschrift*, who has been making a study for some weeks of American power plants, traction systems and hydro-electric developments, sailed for Berlin this week, having found a great deal to interest him in different parts of the country.

MR. GEORGE ARROWSMITH, superintendent of the Northwest Light & Water Company, of North Yakima, Wash., has been appointed superintendent for the Strahorn water, light and power interests in the entire Yakima Valley. The company is preparing to make extensive additions to its system, involving an expenditure of about $250,000.

MR. F. H. MILLENER, of Omaha, Neb., whose scheme for the control of the movement of a storage battery locomotive by wireless telegraphy was outlined in our columns some months ago, presented a paper descriptive of the method and apparatus of his system at the meeting of the Central Electric Railway Association, held at Indianapolis, Ind., on Sept. 24.

STICKNEY-HASNESS.—The marriage took place at Jackson, Mich., on Sept. 21 of Mr. G. H. Stickney, of Lynn, Mass., to Miss Minnie M. Hasness, daughter of Mr. and Mrs. G. D. Hasness, of Jackson. The bridegroom is connected with the illuminating engineering department of the General Electric Company, and graduated from Cornell University in 1896, being a member of the Kappa Sigma fraternity. Mr. and Mrs. Stickney are making a trip to New Orleans and will make their home at Lynn, Mass., after Oct. 15.

MR. F. H. FORD, formerly sales manager of the Peerless Electric Company of Warren, O., with whom he was associated for four years, has become connected with the Mechanical Appliance Company, of Milwaukee, with which he was engaged from 1902 until 1904. Prior to that time Mr. Ford was in the sales department of the Northern Electric Company at its Milwaukee office. This record gives Mr. Ford a very intimate acquaintance with the art and the field, and places him in a most advantageous position for the discharge of his new duties.

MR. ELWOOD GRISSINGER, until recently general agent at Niagara Falls of the Niagara Falls Power Company, has opened an office in the White Building, Buffalo, N. Y., for practice as a consulting electrical and mechanical engineer, with specialties of electrification of industrial plants, advice on power contracts, rate-making and improvement of load factor. Mr. Grissinger graduated with honors from the engineering department of Lehigh University in 1894, and resigned as a district engineer of the Westinghouse Company to become commercial engineer of the Cataract Power & Conduit Company, with which he remained until joining the Niagara Power Company in 1906.

MR. PERCY MAXIM, the well-known electrical engineer and inventor, has lately developed a successful noiseless firearm. As a result, the Maxim Silent Firearms Company was incorporated in Jersey City last week with a capital of $250,000. The incorporators are Sir Hiram Maxim, Percy Maxim, Thaddeus W. Goodrich, and Robert W. Lesley. The company will manufacture silencers and attachments which have been patented by the inventor Maxim. The invention for silencing guns has been tested by Mr. Maxim several times before the United States Army boards during the present year. The click of the hammer and

the thud of the bullet as it struck the target were the only sounds heard when a 32-calibre rifle equipped with the silencer was fired at a range of 250 yards. In addition to its usefulness for army purposes, the inventor says it will be invaluable to the humane slaughtering of animals. He discovered the idea by accident while making other experiments, and now he intends to do away with the click of the hammer, so that a rifle can be fired without the slightest noise.

MR. FRANK H. PARKER, who was elected president of the Vermont Electrical Association at Bennington, Vt., on Sept. 16, is a native of Burlington, Vt., and was graduated as a civil engineer from the University of Vermont in the class of 1874. He was in the employ of the United States Engineer's office, St. Paul, Minn., from August, 1874, to November, 1876. He returned to Burlington on Jan. 4, 1876, to accept the position of treasurer and superintendent of the Burlington Gas Light Company, and has been the local manager of that company and its allied electrical companies continuously from that date. Mr. Parker also served as constructing engineer of the "high service" of the Burlington City Water Works from 1880 to 1882, as superintendent of water works for six years and water commissioner for three years. In 1886 the Burlington Gas Company began furnishing electric light under the title of the Brush-Swan Electric Light Company, and in 1892 that company absorbed the opposition plant of the Citizens' Electric Light Company, when the title was changed to the Consolidated Electric Company. In 1902 the Burlington Light & Power Company was formed for the purpose of operating the plants of the Burlington Gas Light Company, the Consolidated Electric Company, which furnished electric light only, and the Vermont Electric Company, which furnished electric power only, and Mr. Parker is now the local manager of that company. He is a man standing high in the community and has brought to bear on his work a rare degree of engineering skill and ability.

Mr. F. H. Parker.

MR. L. H. CONKLIN has been elected president of the new Pennsylvania Electric Association, the first State body to affiliate with the National Electric Light Association under the new Doherty plan. He was born in Brooklyn Dec. 7, 1872; went through the public schools, and then graduated from Pratt Institute in 1891 in the "technical high schools" course, since abandoned with the development of Pratt work in engineering. Mr. Conklin made himself a thorough master of the machinist's trade and in 1894 went with the old Excelsior Electric Company, of Brooklyn, putting in its arc lighting apparatus in many States. He thus became assistant to that excellent electrical designer and clever inventor, Mr. William Hochhausen, then superintendent of the company. Under him Mr. Conklin did designing and testing. From 1896 until 1900 he was superintendent of the electric lighting plant of the Flatbush Gas Company, of Brooklyn, during which period he remodeled the station and the distribution system. After 1900 for four years Mr. Conklin was engaged in New York in private engineering and contracting, but in 1904 he went to South Carolina, where he invested in and operated for one year a hosiery mill. Returning North he went to Waterbury, Conn., as engineer for Mr. A. M. Young to look after the electrical interests in New England of that well-known manager and organizer of lighting and traction properties. During a period of some two years Mr. Conklin renovated several plants and networks, among them being New London, Rockville and Stafford Springs, Conn. In March, 1907, he joined the forces of the West Penn Railways Company as superintendent of lighting, but after five months was made general superintendent of the entire West Penn system, a position which he now holds.

Mr. L. H. Conklin.

Obituary.

MR. FRANK DE HAAS ROBISON, who was prominent in electric railway development in Cleveland and other Western cities some years ago, died suddenly at his summer home near Cleveland on Sept. 25, of heart disease. He was 56 years of age.

MR. LESLIE CARTER, formerly president of the South Side Elevated Railroad Company of Chicago, died in that city on Sept. 25 after a long illness. He was one of the first men to believe in the applicability of electric traction to elevated roads, and his adoption of the Sprague system in Chicago, and its immediate success, gave a tremendous stimulus to the art, leading to the adoption of electricity on all the other elevated roads in the country.

MR. A. M. BULLARD, an electrical engineer of New York, died at Liberty, N. Y., Sept. 19. After his graduation from the Massachusetts Institute of Technology, he was connected with the Thomson-Houston Company, and later assisted Prof. Elihu Thomson in developing the art of electric welding. In the telephone field he invented the "return coin" device. Since 1900 he was connected with the American Bell Telephone Company in Boston and the Western Electric Company in New York. He was an associate member of the American Institute of Electrical Engineers.

Trade Publications.

NERNST LAMPS.—The Nernst Lamp Company, Pittsburg, Pa., has issued an attractive booklet outlining the numerous advantageous features of the Westinghouse Nernst lamp.

COAL HANDLING MACHINERY.—The Howe Scale Company, Chicago, Ill., has issued a neatly illustrated booklet devoted to machinery equipments for wholesale and retail coal pockets.

METAL REFLECTORS of the Holophane-D'Olier type are discussed in an instructive manner in a well-illustrated bulletin designated as No. 10, issued by the Holophane Company, New York.

STATIONARY TRANSFORMERS.—Bulletin No. 18 of the Wagner Electric Manufacturing Company, St. Louis, Mo., gives a good description of its high efficiency transformers, in the construction of which use is made of steel alloy.

H. T. PAISTE & COMPANY, Philadelphia, Pa., have issued for September an excellent number of *Paistery*, which brings out many features in regard to their Fielding receptacles for "condulets," Paiste taplets, crossovers for open wiring, etc., and gives an illustrated blackboard talk on these last-named devices. There is also a homily on "putting yourself in his place," and being good to the customer.

SMALL MOTORS.—The Emerson Electric Mfg. Co., St. Louis, Mo., has issued bulletin No. 3135, devoted to single-phase induction motors rated at from 0.10 hp to 0.125 hp. Bulletin No. 3958 describes direct-current and alternating-current motors rated at 0.10 hp for driving family washing machines. Alternating-current and direct-current motors for buffing lathes rated at from 0.17 hp to 0.25 hp are discussed in Bulletin No. 3706, of the same company.

LIBERTY MANUFACTURING COMPANY, 6910 Susquehanna Street, Pittsburgh, Pa., has issued Bulletin No. 50, the subject of which is its Liberty-Greenaway separators for steam, oil, ammonia and air. Vertical types are shown designed for a working pressure of 200 pounds steam, and some examples are also illustrated of horizontal. The ammonia separator is of the same general character. The horizontal oil separator has large areas and passages, facilities for easy cleaning, and utilizes gravity as a separating medium.

SIEMENS & HALSKE COMPANY, represented by Dr. K. G. Frank, have opened an office at Room 1559, Hudson Terminal Building, New York City, and have just sent out a catalogue of their testing instruments and accessories. It is 72 pages quarto and includes a wide range of laboratory and portable instruments, measuring transformers, resistances, photometers, testing keys, batteries, condensers, etc. One interesting set of apparatus is for determining losses in core plates. Very full details are given in regard to the instruments and accessories, most of which are illustrated.

Business Notes.

THE HOBART ELECTRIC MANUFACTURING COMPANY, Troy, Ohio, has added two new buildings to its plant. Among new apparatus which it will shortly place on the market is a special 5-hp, direct-current motor.

THE ENGINEERING SERVICE COMPANY has established offices at 90 West Street, New York, for the transaction of a general electrical engineering and contracting business in the equipping of industrial, generating and other plants. The president of the company is Mr. G. B. Werner, while Mr. Robert Josephi is the secretary-treasurer.

ROTH MOTORS.—Roth Bros., Chicago, have received a flattering testimonial from Wayman & Murphy, carriage and wagon manufacturers, on the performance of 30 Roth motors installed in their new plant about a year ago. Thus far the motors, each of which drives a separate machine, have required no expense other than for oil and cleaning.

INTERCITY BASEBALL.—On Saturday, Sept. 26, the New York Edison Association of Employees, 594 strong, went over to Philadelphia on a special train to play baseball with the Athletic Association of the Philadelphia Electric Company. The visitors won the game with a score of 8 to 4. After the hotly contested struggle, which was determined only by the heavy batting of the New Yorkers in the last two innings, the visitors were entertained at the Hotel Majestic with a sumptuous buffet dinner and a concert; and the train returned at 9 p. m. Messrs. J. B. McCall and W. C. L. Eglin spoke for the hosts, and Messrs. T. E. Murray and J. W. Lieb, Jr., were sponsors for the jubilant crowd from Manhattan, who had prepared some original verses for the occasion, of a prophetic nature, utterly lacking in modesty as to their own prowess, but justified by the event.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West 39th St., New York.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, October 30 and 31, 1908.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, Walter S. Mower, London, Ont. Next meeting, Atlantic City, N. J., Oct. 12-16.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, New York, Oct. 13.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. Prescott Folwell, Room 512 Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

AMERICAN STREET & INTERUREAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Atlantic City, N. J., Oct. 12-16.

ASSOCIATION OF CAR LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Chicago. Next meeting, Chicago, Nov. 18.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, S. E. Mumford, Detroit, Mich.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, 559 Frick Building Annex, Pittsburg, Pa. Next meeting October, 1908.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511 Harvester Building, Chicago. Next meeting, Detroit, June 23, 24 and 25, 1909.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronton, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

CHICAGO ELECTRIC CLUB. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Col.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting, New York, October 7.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. General Convention Philadelphia, Oct. 5 and 6.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and 32d St., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., 1909.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ware, Grand Rapids, Mich.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Cedar Rapids, Ia., April, 1909.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

MISSOURI ELECTRIC LIGHT, GAS & STREET RAILWAY ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Temporary chairman, J. D. Crary, Aberdeen, Wash. Next meeting, Seattle, 1909.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, W. A. Rowe, Citizens' Building, Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Galen Crow, Guthrie.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburg, Pa., 1909.

PENNSYLVANIA ELECTRIC ASSOCIATION. E. S. Smith, Tonawanda, Pa., secretary.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass. Monthly meetings, fourth Monday each month. Next annual meeting, fourth Monday in February, 1909.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 22, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

899,024. PARTY-LINE-INDICATING KEY; Clifford C. Bradbury, Chicago, Ill. App. filed Aug. 3, 1907. An operator's indicating key, a plurality of switch actuating buttons, each button having a normal unactuating position, a depressed actuating position and a partially rotated unactuating indicating position.

899,059. INSULATOR FOR ARMATURE CONDUCTORS; Allert R. Locke, Chicago, Ill. App. filed Dec. 20, 1907. A closed insulating hood adapted to partially surround portions of armature conductors that are joined by soldering, whereby the melted solder, due to the abnormal heat of the conductor, may be caught and retained in intimate contact with the joined conductors until it cools.

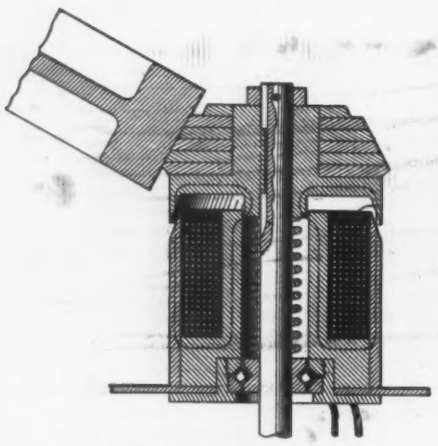
899,088. GOVERNOR FOR DYNAMOS; Charles L. Weichelt, Philadelphia, Pa. App. filed Dec. 11, 1907. A dynamo for ignition purposes frictionally driven from the flywheel of an engine. Has a magnetic clutch operating to keep the speed constant in lieu of the usual centrifugal devices.

899,120. RAIL-BOND; George Alvin Mead, Mansfield, Ohio. App. filed March 20, 1906. The bond is made of a bundle of copper wires swaged to form terminal lugs at the ends, which are afterward welded into a unitary mass. Has a sheet metal protector for the swaged ends to prevent the copper from being burned in the welding process.

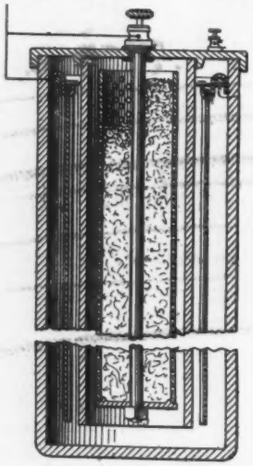
899,127. MEANS FOR PROTECTING HIGH-TENSION OVERHEAD ELECTRIC CONDUCTORS; Lucien Neu, Lille, France. App. filed April 3, 1906. Provides the line with disconnectors coming automatically into action in case of breakage of one of the conductors. Has an auxiliary source of high-frequency alternating currents and relays subjected thereto and in shunt to a line to be protected.

899,134. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; Ara P. Rickmire, Waterloo, Ia. App. filed Dec. 30, 1907. A signal system for railroads, designed to prevent collisions at crossings and other accidents. Has a cab signal and automatic train stop, and includes entire mechanical and electrical equipment.

899,145. ELECTRICAL SYSTEM OF DISTRIBUTION; William A. Turbayne, Lancaster, N. Y. App. filed Feb. 25, 1907. Train lighting system of type having a main dynamo on one of the train units capable of supplying substantially all the lights of the train and a storage battery on each car, the storage battery being employed when the car is detached. Relates to features of the storage battery circuit.



899,088.—Governor for Dynamos.



899,226.—Electroplating Apparatus.

899,181. ELECTRIC GAS LIGHTER; James D. McIntyre, Newman, Ill. App. filed March 4, 1907. A small device having somewhat the outline of a pistol and, including a spark gap at a point, which is manipulated by an action somewhat similar to cocking the trigger of a firearm.

899,189. ELECTROMOTOR CONTROLLING AND OPERATING SYSTEM FOR ELECTRIC RAILWAYS AND POWER PLANTS; Johann Sahulka, Vienna, Austria-Hungary. App. filed June 1, 1907. A system of controlling and operating motors and shafts for electric railways and power plants, in which the motor actuates, on the one hand, a driven shaft and, on the other, a dynamo which supplies current to a second motor, also actuating a driven shaft.

899,193. AUTOMATIC ELECTRICAL MEASURING APPARATUS; Daniel J. Shine, Las Vegas, Nev. App. filed March 4, 1907. A means for applying a variable resistance in connection with an electric circuit, whose existence is to be determined, and automatically varying said varible resistance until it balances or bears a definite ratio to that of the resistance to be measured.

899,205. ELECTRIC SWITCH; Charles A. Clark, Hartford, Conn. App. filed May 24, 1907. A two-button snap-switch designed to have a minimum amount of wear, and consequently a positive operation for the longest possible time. Includes a double pawl, which is displaced at the limit of movement of the spring actuator for the switch element.

899,209. AUTOMATIC TELEGRAPH; P. B. Delany, South Orange, N. J. App. filed Dec. 15, 1896. Automatic telegraph employing a perforating tape at the sending end and recording device at the receiving end. Employs a transmitting tape with three rows of perforations, one for transmitting dots, one for dashes, and a third for grounding the line, and having as many perforations in it as there are perforations in both other rows.

899,220. AUTOMATIC ELECTRIC SAFETY DEVICE FOR BOILERS, ETC.; Charles Kausen, of New York, N. Y. App. filed March 13, 1908. A low-water alarm for boilers, including a float connected to a rotatable element which swings into a position to complete a circuit when the float drops to a predetermined level.

899,226. ELECTROPLATING APPARATUS; George A. Lutz, of Plainfield, N. J. App. filed June 6, 1908. An electroplating anode, comprising a perforated insulator and particles of plating material supported thereon and a rod passing through to support said insulator.

899,228. SAFETY APPARATUS FOR CARS; Theodore A. Mayer, Washington, D. C. App. filed March 17, 1908. The controller has a locking device magnetically connected with the step of the car, so that the motorman cannot start the car until a passenger has alighted.

899,239. SIGNALING SYSTEM; Sewall Cabot, Brookline, Mass. App. filed March 10, 1906. Wireless telegraph system which may be operated in connection with existing wire telegraph systems without changing any of the operating features thereof. Designed to be operated so as to automatically bridge by wireless telegraphy any gaps which there may be in the wire line due to intervening property rights or the like.

899,240. SIGNALING SYSTEM; Sewall Cabot, Brookline, Mass. App. filed March 10, 1906. Relates to additional features of the above.

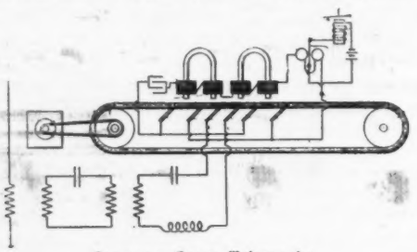
899,241. SIGNALING SYSTEM; Sewall Cabot, Brookline, Mass. App. filed March 10, 1906. Covers additional features and modifications.

899,243. SIGNALING SYSTEM; Sewall Cabot, Brookline, Mass. App. field March 10, 1906. Relates to the application of the above to quadruplex telegraphy.

899,243. SPACE TELEGRAPHY; Sewall Cabot, Brookline, Mass. App. filed April 4, 1906. A form of detector for use with the above system. Has a dynamo electric machine with field coils and an armature winding, means connecting said armature winding and said field coils in series, a condenser in series with said field coils and armature winding, and means for varying the magnetic flux threading said armature winding by the electrical oscillations to be detected.

899,264. OSCILLATION DETECTOR; Charles E. Russell, Cambridge, Mass. App. filed Sept. 4, 1906. A magnetic detector which does not require a cyclically varying magnetic field.

899,272. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE-TELEGRAPH SIGNALS; John Stone Stone, Cambridge, Mass. App. filed Aug. 17, 1906. System whereby the bearing or direction of the transmitting system from the receiving system may be determined by observing at the receiving station the direction of motion of the electromagnetic waves which emanate from the transmitting system.



899,243.—Space Telegraphy.

899,278. TELEPHONE SWITCHBOARD; Charles E. Wilson, Philadelphia, Pa. App. filed Sept. 10, 1904. In a telephone switchboard, the combination with a group of answering jacks arranged in vertical and horizontal rows; a group of multiple jacks above the answering jacks and correspondingly located; and a separate group of independent manually operated call registering devices arranged in similarly grouped rows above the multiple jacks, said individual registering devices being arranged in the same relative position in their group as are the corresponding answering jacks and multiple jacks in their group.

899,307. TELEGRAPH SOUNDER; Lee Kiblinger, Jackson, La. App. filed Nov. 18, 1907. Form of sounder having electromagnets with wide flat pole pieces extending directly across the length of the armature lever for the purpose of equalizing the density of the magnet field between the armature and different parts of the pole pieces.

899,348. MAGNETIC ORE SEPARATOR; Charles E. Stebbins, Iola, Kan. App. filed April 17, 1908. A rotating head in which provision is made for separating the magnets of co-operating parts in a simple and effective manner, whereby the parts may be conveniently assembled and disassembled in the operation of installing a separator and repairing the same.

899,358. ARRANGEMENT OF PROTECTIVE APPARATUS; Hermon L. Van Valkenburg, Norwood, Ohio. App. filed Sept. 29, 1906. The different poles of multipole switching apparatus and the busbars are so arranged that long cables and complicated connections between the switches and busbars are avoided, whereby the switches can be easily connected to or disconnected from the busbars.

899,370. DYNAMO-ELECTRIC MACHINE OF THE INCLOSED TYPE; Alfred H. Wouters, Norwood, Ohio. App. filed March 18, 1907. Construction of inclosed dynamo-electric machines, which are cooled by a forced circulation of air. Includes a housing for the air-receiving chamber and air-admission chamber, and which has a shaft passing through the end walls of the housing, and walls for extending said admission chamber around the shaft for spacing the extended portion from the end of the housing and from the shaft.

899,379. PARTY-LINE-INDICATING KEY; Clifford C. Bradbury, Chicago, Ill. App. filed March 11, 1907. A self-indicating operator's key, a plurality of levers, switch springs actuated by the tilting of said levers, and means for causing the levers themselves to indicate the last set of switch springs actuated and released.

899,449. DYNAMO-ELECTRIC MACHINE; Allan B. Field, Norwood, Ohio. App. filed Nov. 30, 1906. An anti-hunting device designed to prevent irregularity of movement in alternating generators, synchronous motors, rotary converters and the like. Has resistance rings and bars imbedded in the pole laminations of the field magnet.

899,474. TROLLEY WHEEL; Joseph W. Seibert, Washington, Pa. App. filed Feb. 5, 1908. The trolley wheel is made with star-shaped spokes projecting beyond its flanges which have hooked extremities designed to close over the trolley conductor.